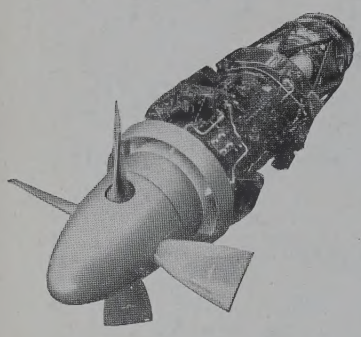
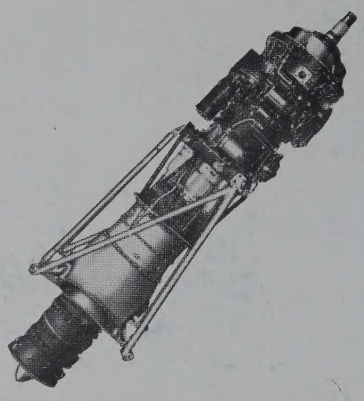
JANE'S ALL THE WORLD'S AIRCRAFT

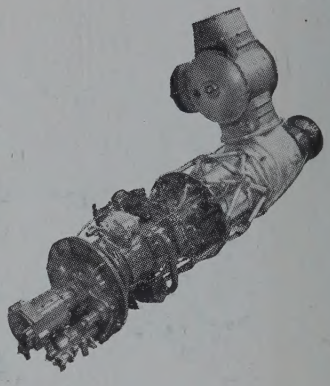
1958-1959



ELAND (for fixed wing aircraft) propeller-turbine engine for new airliners and conversion of piston engine airliners to propeller-turbine power. Chosen for the Hamburger Flugzeugbau C209 and the Convair 340.

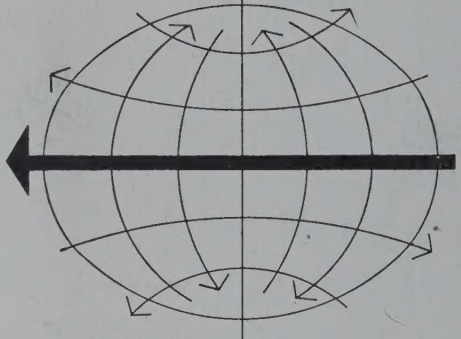


ELAND (for helicopters) specially designed for the Fairey Rotodyne, is basically the standard Eland with an auxiliary compressor mounted at the rear. A further design with a rear gear box is installed in the Westland Westminster helicopter.

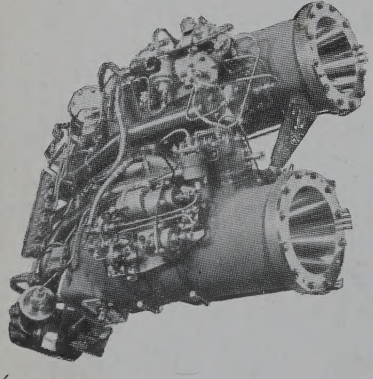


ORYX turbo gas generator designed for helicopters where the rotor is propelled by jet reaction at the blade tips.

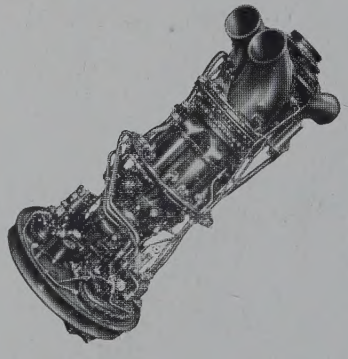
NAPIER AERO ENGINES



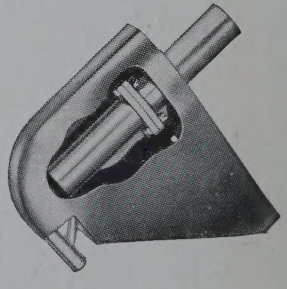
for the world



DOUBLE SCORPION an aircraft rocket engine which provides a source of extra power at high altitude. Designed for sustained firing and long operational life. Fitted in the Canberra which set up a height record of 70,310 ft.



GAZELLE free turbine engine designed primarily for helicopter propulsion. Chosen for the Westland Wessex and the Bristol 192. Can be adapted for fixed-wing applications.



TIP THRUST UNITS for helicopters restore performance lost through heat, humidity and height. In operation in the Saunders Roe Skeeter.

D. NAPIER & SON LIMITED · LONDON · W.3. *Member of the ENGLISH ELECTRIC Aviation Group*

CRCS.36

REFERENCE ONLY



THE DE HAVILLAND

COMET

(Four Rolls-Royce Avon jet engines)

for Argentina's main-line operations in the American hemisphere

whatever happens in the air...

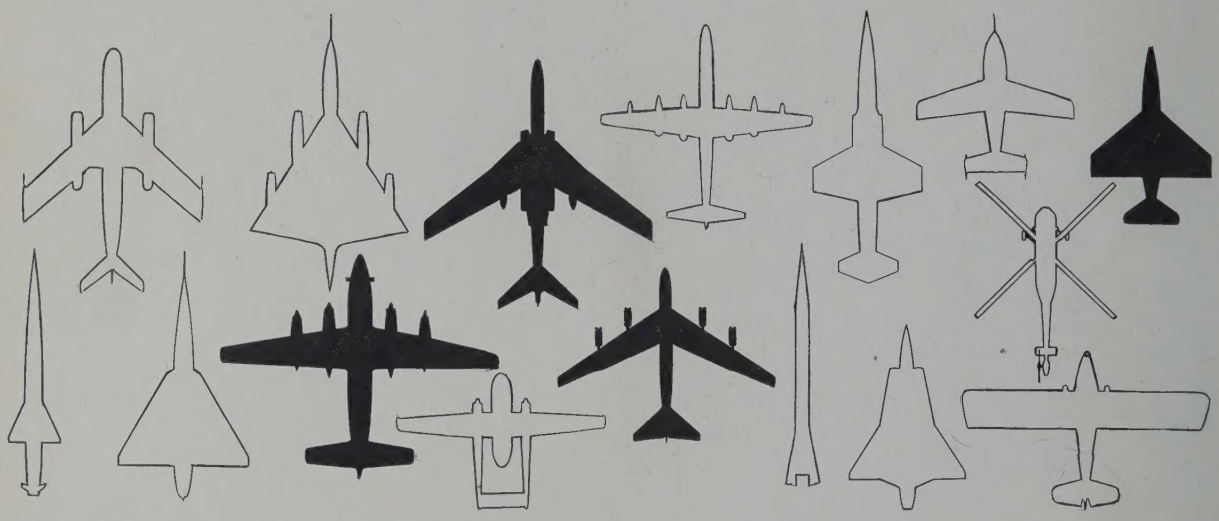
FLIGHT offers an unequalled weekly survey of world progress in commercial, civil and military aviation. Authoritative articles record and interpret every major development in research, construction, operation and maintenance. Detailed technical information is given on aircraft of every nation, and notes on private and Club flying, and reports of papers from the Royal Aeronautical and other Societies are included. FLIGHT's photographs and functional drawings are the finest available.

Annual subscription £4.15.0. (Home). £5.0.0. (Overseas). U.S.A. and Canada $15.00.

FLIGHT

FRIDAYS 1s. 6d.

THE WORLD'S FOREMOST AERONAUTICAL WEEKLY



or on the ground

AIRCRAFT PRODUCTION covers the most modern processes of aircraft, engine, and component production. New developments in machine-tool practice are described, and up-to-date information given on the selection and treatment of materials, factory construction and organization, and efficient use of equipment.

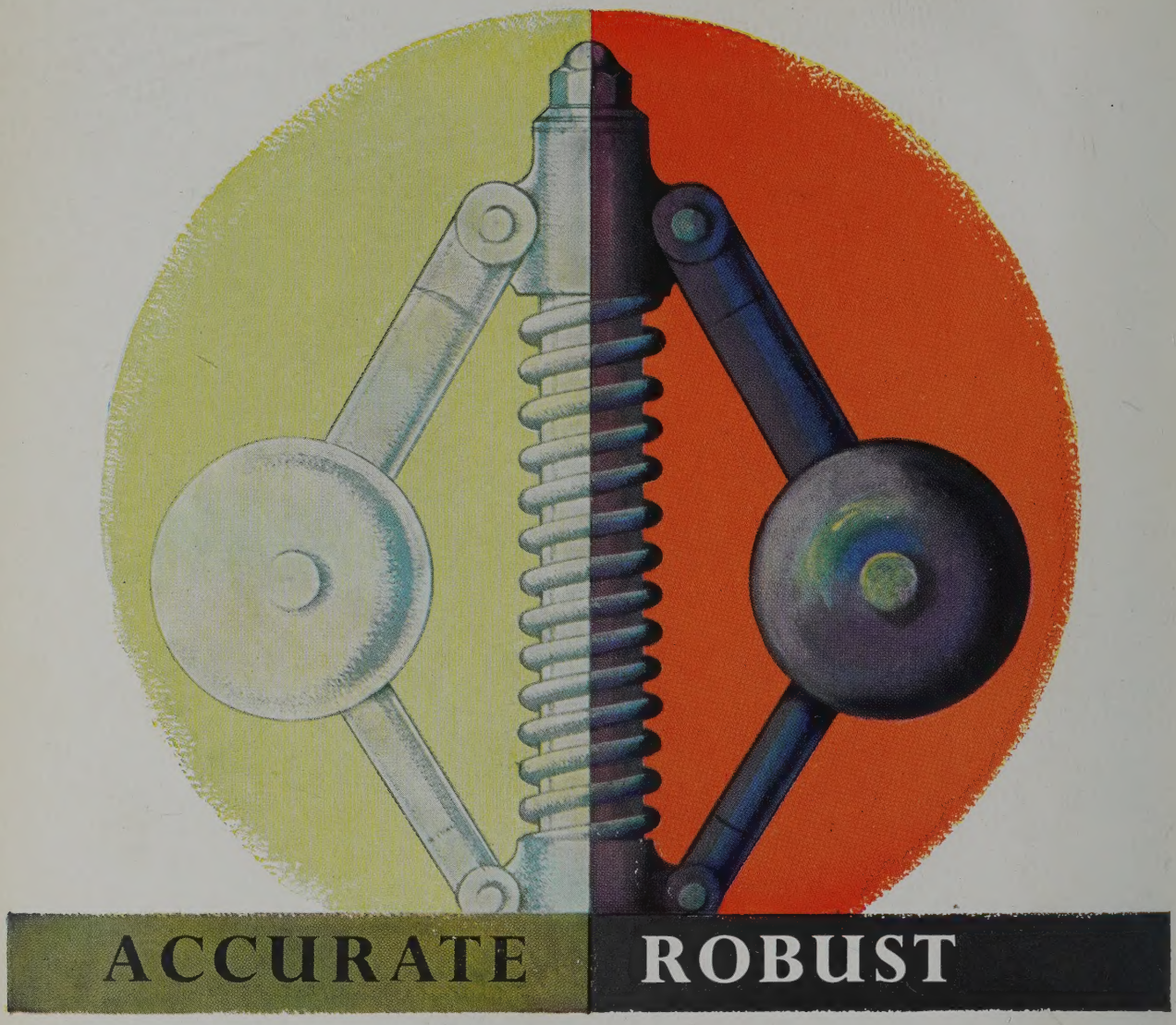
Monthly 3s. 6d. Annual subscription £2.10.0. U.S.A. and Canada $7.00.

AIRCRAFT PRODUCTION

The journal of Britain's aircraft manufacturing industry

PUBLISHED BY ILIFFE & SONS LIMITED DORSET HOUSE STAMFORD STREET LONDON SE1 ENGLAND


THE INCOMPARABLE
P.1B
ENGLISH ELECTRIC
aircraft
The ENGLISH ELECTRIC Company Limited · Marconi House · Strand · London WC2



Evolved after many years of specialization, the Iso-Speedic governor controls speed to an extraordinary degree of accuracy, due to the elimination of static friction by rolling flybobs.

Iso-Speedic governors can be supplied which control speed within 0.3 per cent: others are available where a lower degree of accuracy is sufficient.

THE ISO-SPEEDIC COMPANY LTD., FRIAR'S ROAD, COVENTRY
Telephone: Coventry 3147 Telegrams: Isospeedic Coventry

Iso-Speedic

JANE'S
ALL THE WORLD'S AIRCRAFT

EDITORIAL OFFICES:

All communications for the Editor should be addressed to:

THE EDITOR, JANE'S ALL THE WORLD'S AIRCRAFT,
25, GILBERT STREET, LONDON, W.1.

ADVERTISEMENT OFFICES:

All communications in regard to advertising should be addressed to:

THE ADVERTISEMENT MANAGERS, JANE'S ALL THE WORLD'S AIRCRAFT,
THE TRADE PRESS ASSOCIATION LTD., "BERNERS HOUSE," 47-48, BERNERS STREET, LONDON, W.1.



Bristol "Britannia"
No. 2 Bulkhead

Precision built
by CORNERCROFT
for the Bristol "Britannia"

One of these jobs we are proud to do—and we think you will see this reflected in the very high standard of workmanship embodied in this bulkhead assembly, in fact, you'll see it in all Cornercroft work—in airframe assemblies and components, metal spinnings and pressings, sheet metal work, assembly and drill jigs, tools, checking gauges, etc. If you seek these standards, can we discuss your needs . . . a very complete engineering organization, including a great deal of experience and skill, is at your disposal.

CORNERCROFT
GROUP OF COMPANIES

NC.273

CORNERCROFT LIMITED (THE CORNERCROFT GROUP OF COMPANIES), ACE WORKS, COVENTRY TELEPHONE : COVENTRY 40561

8 RCA 29.13

ALPHABETICAL LIST OF ADVERTISERS.

1958/9 EDITION.

	PAGE
A.B.C. Motors Ltd.	88 adv.
Aero Research Ltd.	57 „
Air Trainers Ltd.	84 „
Alvis Ltd.	12 „
Amal Ltd.	27 „
Automotive Products Co., Ltd. (Avery Wheels and Lockheed Equipment)	20 „
Avco—Lycoming (U.S.A.)	26 „
Avions Hurel-Dubois (France)	74 „
Avro Aircraft Ltd.	65 „
BP Aviation Service	55 „
Barr & Stroud Ltd.	*Inside back cover*
Bellman Hangars Ltd.	103 adv.
Blackburn and General Aircraft Ltd.	28 „
Boeing Aircraft (U.S.A.)	22 „
Boorn, Thomas & Co., Ltd.	31 „
Boulton Paul Aircraft Ltd.	47 „
Bristol Aeroplane Co., Ltd., The	39 & 40 „
British Aviation Insurance Co., Ltd., The	67 „
British Oxygen Aro Equipment Ltd.	90 „
British Petroleum Co., Ltd., The	55 „
British Thomson-Houston Co., Ltd., The	41 „
Brown, David Foundries Co., The	54 „
Brown, David, Tractors Ltd.	80 „
Brown, S. G., Ltd.	85 „
Bryans Aeroquipment Ltd.	45 „
Burnley Aircraft Products Ltd.	66 „
Butlers Ltd.	59 „
Cellon Ltd.	43 „
Chain Belt Company (Shafer Division) (U.S.A.)	100 „
Cornercroft Group of Companies, The	6 „
Cory Brothers & Co. Ltd. (Survival Equipment Division)	77 „
Curran, John, Ltd.	63 „
de Havilland Enterprise, The	2 & 30 „
Desoutter Bros., Ltd.	16 „
Dornier-Werke G.m.b.H. (Germany)	64 „
Douglas Aircraft Company, Inc. (U.S.A.)	58 „
Dunlop Rubber Co., Ltd.	98 „
Edwards, F. J., Ltd.	9 „
Elliot Equipment Ltd.—see Cory Brothers & Co., Ltd.	77 „
English Electric Co., Ltd., The	4 & 86 „
Esso Aviation Products	79 „
Fairey Aviation Co., Ltd., The	34 adv.
Ferranti Ltd.	81 „
Fokker, Royal Netherlands Aircraft Factories (Holland)	60 „
Fiat S.p.A. (Italy)	62 „
Folland Aircraft Ltd.	38 „
Fox, Samuel & Co., Ltd.	97 „
G. Q. Parachute Co., Ltd., The	68 „
Garringtons Ltd.	10 „
Goodyear Tyre & Rubber Co. (Gt. Brit.) Ltd., The	49 „
H.M.L. (Engineering) Ltd.	35 „
Habershon, J. J. & Sons, Ltd.	61 „
Handley Page Ltd.	92 „
Hawker Siddeley Group Ltd.	14 „
Heenan & Froude Ltd.	24 „
High Duty Alloys Ltd.	37 „
Hindustan Aircraft Ltd. (India)	53 „
Hispano Suiza (France)	51 „
Hobson, H. M., Ltd.	33 „
Hunting Aircraft Ltd.	36 „
Iliffe & Sons Ltd.	3 „
Integral Ltd.	86 „
Irving Air Chute of Great Britain Ltd., The	76 „
Iso-Speedic Co., Ltd., The	5 „
Jessop, William & Sons, Ltd.	95 „
Kidde, Walter Co., Ltd., The	71 „
Kollsman Instrument Corporation (U.S.A.)	102 „
Low Moor Alloy Steelworks Ltd.	19 „
Low Moor Fine Steels Ltd.	19 „
Lycoming (U.S.A.)	26 „
M.L. Aviation Co., Ltd.	83 „
M.S.S. Recording	84 „
Marconi's Wireless Telegraph Co., Ltd.	94 „
Marston Excelsior Ltd.	85 „
Martin, The Glenn L. Company (U.S.A.)	56 „
Martin-Baker Aircraft Co., Ltd.	96 „
Mills Equipment Co., Ltd., The	88 „

Wessex



The Most Advanced Anti-Submarine HELICOPTER in the world

Naval staffs of the maritime countries of the world have established that the helicopter is the modern defence weapon against the submarine.

It detects and destroys.

The Westland Wessex is the most advanced helicopter in the world for countries exposed to submarine attack. It is in quantity production for the Royal Navy.

WESTLAND HELICOPTERS

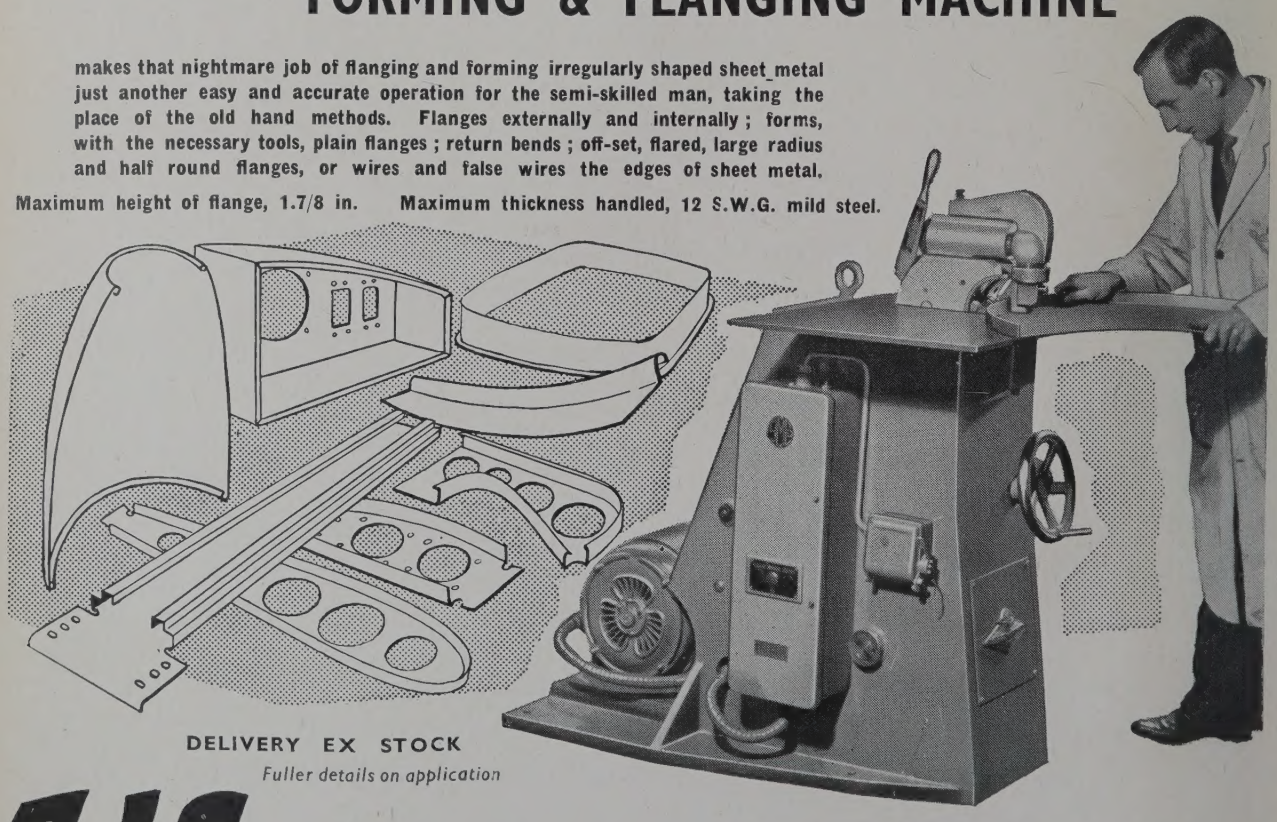
WESTLAND AIRCRAFT LIMITED YEOVIL ENGLAND

	PAGE
Napier, D., & Son Ltd.	*Inside front cover*
Newton Bros. (Derby) Ltd.	69 adv.
Omnipol Ltd.	52 „
Orenda Engines Ltd. (Canada)	73 „
Piper Aircraft Corporation (U.S.A.)	50 „
Plessey Co., Ltd., The	93 „
Redifon, Ltd.	99 „
Republic Aviation Corporation (U.S.A.)	48 „
Roe, A. V., Canada, Ltd. (Canada)	65 „
Rolls-Royce Ltd.	89 „
Salter, Geo. & Co., Ltd.	82 „
Sampson Low, Marston & Co., Ltd.	83 & 88 „
Scottish Aviation Limited	17 „
Short Bros. & Harland, Ltd.	32 „
Siebe, Gorman & Co., Ltd.	82 „
Société Nationale de Constructions Aéronautiques du Nord (France)	72 adv.
Sperry Gyroscope Co., Ltd., The	44 „
Standard Telephones & Cables Ltd.	29 „
Sud Aviation	46 „
Svenska Aeroplan A.B. (Saab Aircraft Co.) (Sweden)	91 „
Thompson Brothers (Bilston) Ltd.	75 „
Titanine Ltd.	78 „
United Steel Companies Ltd., The	97 „
Vickers-Armstrongs Ltd.	70 „
Vinten, W., Ltd.	87 „
Vosper Ltd.	42 „
Western Manufacturing (Reading) Ltd.	87 „
Westland Aircraft Ltd.	8 „
Wiggin, Henry & Co., Ltd.	101 „
Yorkshire Engineering Supplies Ltd.	88 „

The BESCO HS SHEET METAL FORMING & FLANGING MACHINE

makes that nightmare job of flanging and forming irregularly shaped sheet metal just another easy and accurate operation for the semi-skilled man, taking the place of the old hand methods. Flanges externally and internally; forms, with the necessary tools, plain flanges; return bends; off-set, flared, large radius and half round flanges, or wires and false wires the edges of sheet metal.

Maximum height of flange, 1.7/8 in. Maximum thickness handled, 12 S.W.G. mild steel.



DELIVERY EX STOCK

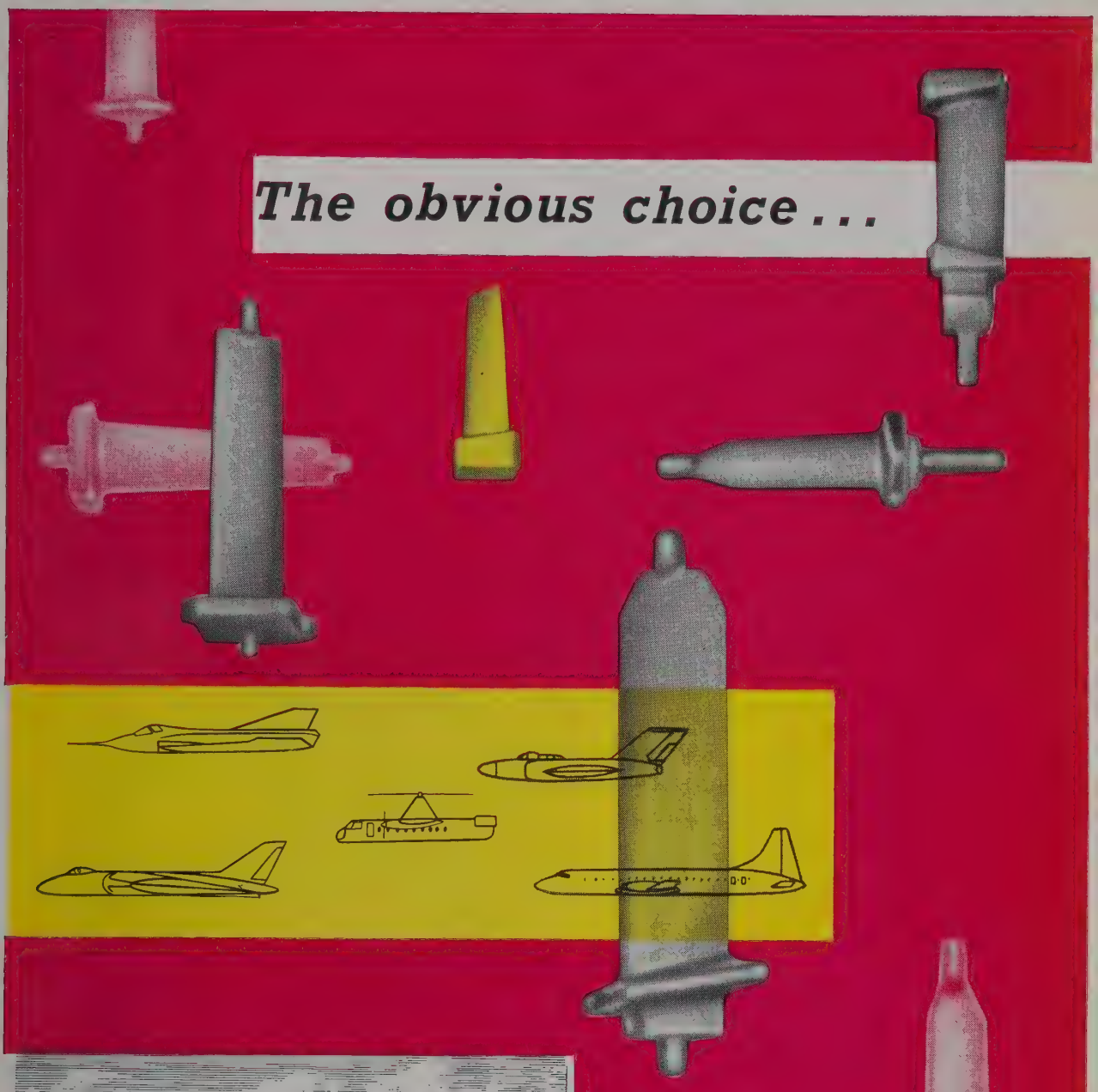
Fuller details on application

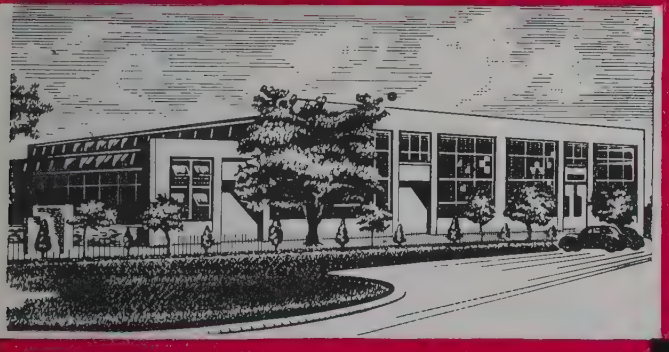
F.J. Edwards Ltd

EDWARDS HOUSE, 359-361 EUSTON ROAD, LONDON, N.W.1
Phones: EUSton 4681 & 3771 Grams: Bescotools Norwest London
LANSDOWNE HOUSE, 41 WATER STREET, BIRMINGHAM, 3
Phones: CENtral 7606/8 Grams: Bescotools Birmingham 3

9 adv.

The obvious choice . . .





These blades are precision forged in the new forging shop specially built and specially equipped, with the largest capacity in Europe for the production of forgings for the Aircraft Industry.

The materials forged include STAINLESS STEELS, ALUMINIUM ALLOYS, ALUMINIUM BRONZES, NICKEL ALLOYS AND TITANIUM ALLOYS.

precision blades by GARRINGTONS

GARRINGTONS LTD., BROMSGROVE, WORCS

CLASSIFIED LIST OF ADVERTISERS—*continued.*

ACCESSORIES PAGE
Dunlop Rubber Co., Ltd. .. 98 adv.
Integral Ltd. .. .. .. 86 ,,
Iso-Speedic Co., Ltd., The .. 5 ,,
Marston Excelsior Ltd. .. 85 ,,
Mills Equipment Co., Ltd., The 88 ,,
Plessey Co., Ltd., The .. 93 ,,
Siebe, Gorman & Co., Ltd. .. 82 ,,
Vickers-Armstrongs Ltd. .. 70 ,,

ACCUMULATORS, HYDRAULIC
Automotive Products Co., Ltd. 20 ,,
Dunlop Rubber Co., Ltd. .. 98 ,,
Fairey Aviation Co., Ltd., The 34 ,,
H.M.L. (Engineering) Ltd. .. 35 ,,

ACCUMULATORS, HYDRAULIC, AIR OR WEIGHT LOADED
Automotive Products Co., Ltd. 20 ,,
H.M.L. (Engineering) Ltd. .. 35 ,,

ACTUATORS, ELECTRIC
British Thomson-Houston Co., Ltd., The .. .. .. 41 ,,
English Electric Co., Ltd., The 4 & 86 ,,
Plessey Co., Ltd., The .. 93 ,,
Western Manufacturing (Reading) Ltd. .. .. 87 ,,

ADHESIVES
Aero Research Ltd. (Redux) 37 ,,
Cellon Ltd. .. .. .. 43 ,,
Goodyear Tyre & Rubber Co. (Gt. Brit.) Ltd., The .. 49 ,,

AERIAL SURVEY INSTRUMENTS
Barr & Stroud Ltd. *Inside Back Cover*

AERO AUXILIARY EQUIPMENT
A.B.C. Motors Ltd. .. .. 88 adv.
Brown, S. G., Ltd. .. .. 85 ,,
Dunlop Rubber Co., Ltd. .. 98 ,,

AERO-ENGINE TEST PLANT
Curran John, Ltd. .. .. 63 ,,
Heenan & Froud Ltd. .. 24 ,,
M.S.S. Recordings Co. Ltd. .. 84 ,,
Roe, A. V. Canada, Ltd. .. 65 ,,

AERO-ENGINES
Alvis Ltd. .. .. .. 12 ,,
Avco-Lycoming .. .. 26 ,,
Blackburn & General Aircraft Ltd. .. .. 28 ,,
Bristol Aeroplane Co., Ltd., The 39 & 40 ,,
de Havilland Enterprise, The 2 & 30 ,,
Fiat S.p.A. .. .. .. 62 ,,
Hawker Siddeley Group Ltd. 14 ,,
Hispano Suiza .. .. .. 51 ,,
Napier, D., & Son, Ltd. *Inside front cover*
Roe, A. V. Canada, Ltd. .. 65 adv.
Rolls-Royce Ltd. .. .. 89 ,,

AERONAUTICAL ENGINEERS AND CONSULTANTS
A.B.C. Motors Ltd. .. .. 88 ,,
Short Bros. & Harland Ltd. .. 32 ,,

AIR CAMERAS
Vinten, W. Ltd. .. .. 87 ,,

AIR COMPRESSORS
Avco-Lycoming .. .. 26 ,,
Dunlop Rubber Co., Ltd. .. 98 ,,
Siebe Gorman & Co., Ltd. .. 82 ,,

AIR COMPRESSORS FOR ENGINE STARTING
Avco-Lycoming .. .. 28 ,,
Siebe Gorman & Co., Ltd. .. 82 ,,

AIR CONDITIONING
M.L. Aviation Co., Ltd. .. 83 ,,

AIR CONTROL EQUIPMENT FOR CABINS PAGE
Kollsman Instrument Corporation (U.S.A.) .. .. 102 adv.
Marston Excelsior Ltd. .. 85 ,,

AIR FILTERS
Fiat S.p.A. .. .. .. 62 ,,

AGRICULTURAL AIRCRAFT (DUSTERS AND SPRAYERS)
Dornier-Werke G.m.b.H. .. 64 ,,
Piper Aircraft Corporation .. 50 ,,

AIRCRAFT—AMBULANCE
Blackburn & General Aircraft Ltd. .. .. 28 ,,
Bristol Aeroplane Co., Ltd., The 39 & 40 ,,
de Havilland Enterprise, The 2 & 30 ,,
Dornier-Werke G.m.b.H. .. 64 ,,
Omnipol Ltd. (Czechoslovakia) 52 ,,
Hunting Aircraft .. .. 36 ,,
Scottish Aviation Limited .. 17 ,,
Short Bros. & Harland Ltd. .. 32 ,,
Svenska Aeroplan A.B. (Saab Aircraft Co.) .. .. 91 ,,
Vickers-Armstrongs Ltd. .. 70 ,,
Westland Aircraft Ltd. .. 8 ,,

AIRCRAFT—AMPHIBIAN
Folland Aircraft Ltd. .. .. 38 ,,
Martin, The Glenn L. Co. 56 ,,
Short Bros. & Harland Ltd. .. 32 ,,
Vickers-Armstrongs, Ltd. .. 70 ,,

AIRCRAFT—COMMERCIAL
Avions, Hurel-Dubois .. .. 74 ,,
Blackburn & General Aircraft Ltd. .. .. 28 ,,
Boeing Airplane Company .. 22 ,,
Bristol Aeroplane Co., Ltd., The 39 & 40 ,,
de Havilland Enterprise, The 2 & 30 ,,
Douglas Aircraft Co. Inc. (U.S.A.) 58 ,,
Fokker, N. V. Koninkluke Nederlandse Vliegtuigenfabriek 60 ,,
Folland Aircraft Ltd. .. 38 ,,
Handley Page Ltd. .. .. 92 ,,
Martin, The Glenn L. Co. 56 ,,
Hunting Aircraft .. .. 36 ,,
Piper Aircraft Corporation .. 50 ,,
Scottish Aviation Limited .. 17 ,,
Short Bros. & Harland Ltd. 32 ,,
Svenska Aeroplan A.B. (Saab Aircraft Co.) .. .. 91 ,,
Vickers-Armstrongs Ltd. .. 70 ,,
Westland Aircraft Ltd... .. 8 ,,

AIRCRAFT—EXPERIMENTAL
Société Nationale de Constructions Aéronautiques du Nord 72 ,,

AIRCRAFT—FLYING BOAT
Folland Aircraft Ltd. .. .. 38 ,,
Martin, The Glenn L. Co. 56 ,,
Short Bros. & Harland Ltd. 32 ,,

AIRCRAFT—GLIDER
Omnipol Ltd. (Czechoslovakia) 52 ,,
Short Bros. & Harland Ltd. .. 32 ,,

AIRCRAFT—JET PROPELLED
Avro Aircraft Ltd. .. .. 65 ,,
Boeing Airplane Company .. 22 ,,
Boulton Paul Aircraft Ltd. .. 47 ,,
Bristol Aeroplane Co., Ltd., The 39 & 40 ,,
de Havilland Enterprise, The 2 & 30 ,,
Douglas Aircraft Co. Inc. (U.S.A.) 58 ,,
Fiat S.p.A. .. .. .. 62 ,,
Fokker, N. V. Koninkluke Nederlandse Vliegtuigenfabriek 60 ,,

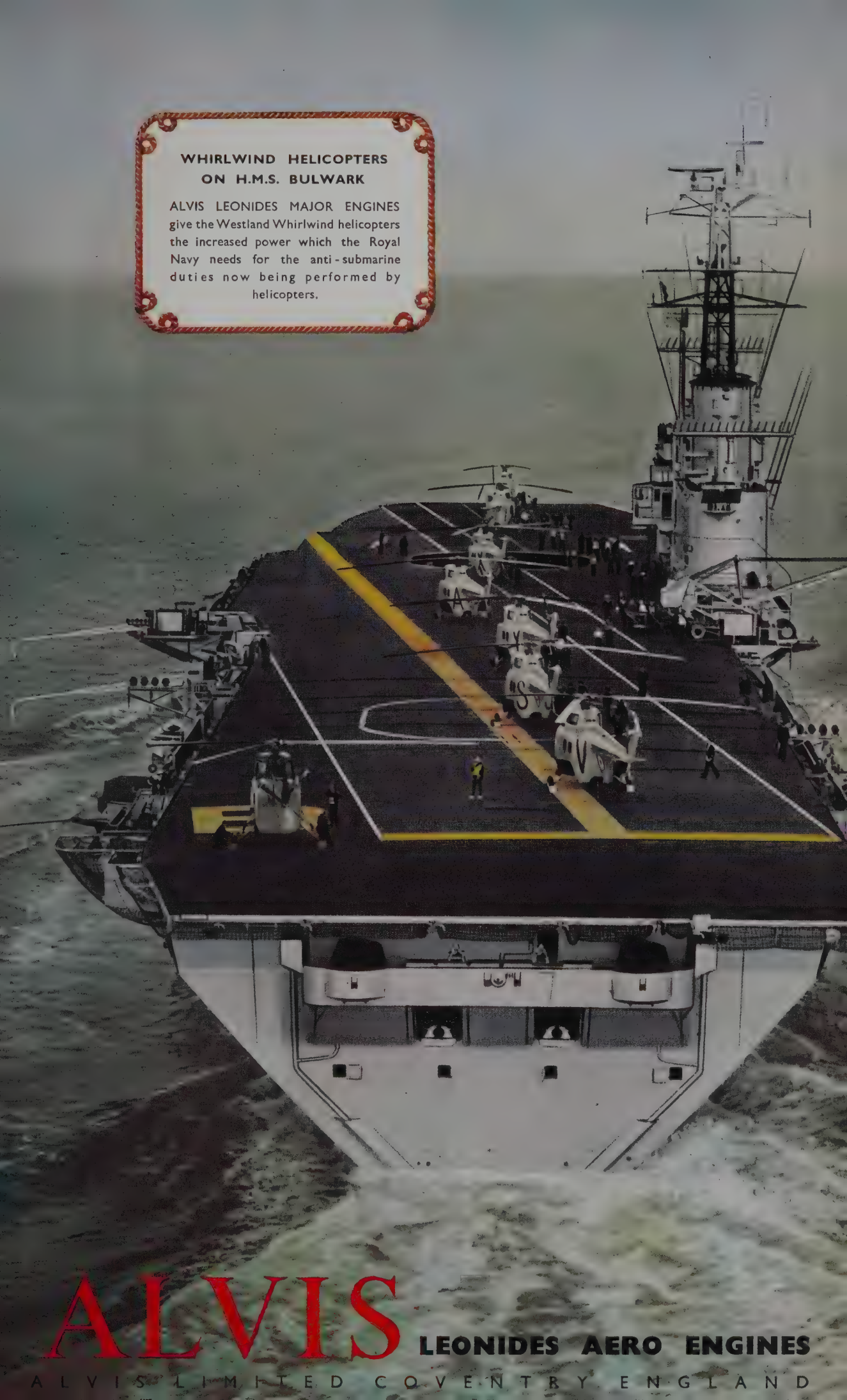
AIRCRAFT JET PROPELLED—*cont.*
PAGE
Folland Aircraft Ltd. .. 38 adv.
Handley Page Ltd. .. .. 92 ,,
Hawker Siddeley Group Ltd. .. 14 ,,
Martin, The Glenn L. Co. .. 56 ,,
Hunting Aircraft Ltd. .. 36 ,,
Republic Aviation Corp. (U.S.A.) 48 ,,
Roe, A. V. Canada, Ltd. .. 65 ,,
Short Bros. & Harland Ltd. .. 32 ,,
Société Nationale de Constructions Aéronautiques du Nord 72 ,,
Svenska Aeroplan A.B. (Saab Aircraft Co.) .. .. 91 ,,
Vickers-Armstrongs Ltd. .. 70 ,,

AIRCRAFT—LANDPLANE
Blackburn & General Aircraft Ltd. .. .. .. 28 ,,
Boeing Airplane Company .. 22 ,,
Boulton Paul Aircraft Ltd. .. 47 ,,
Bristol Aeroplane Co., Ltd., The 39 & 40 ,,
de Havilland Enterprise, The 2 & 30 ,,
Dornier-Werke G.m.b.H. .. 64 ,,
Fokker, N. V. Koninkluke Nederlandse Vliegtuigenfabriek 60 ,,
Folland Aircraft Ltd. .. .. 38 ,,
Handley Page Ltd. .. .. 92 ,,
Hawker Siddeley Group Ltd. .. 14 ,,
Martin, The Glenn L. Co. .. 56 ,,
Omnipol Ltd. (Czechoslovakia) 52 ,,
Hunting Aircraft Ltd. .. 36 ,,
Piper Aircraft Corporation .. 50 ,,
Scottish Aviation Limited .. 17 ,,
Short Bros. & Harland Ltd. .. 32 ,,
Société Nationale de Constructions Aéronautiques du Nord 72 ,,
Svenska Aeroplan A.B. (Saab Aircraft Co.) .. .. .. 91 ,,
Vickers-Armstrongs Ltd. .. 70 ,,
Westland Aircraft Ltd. .. 8 ,,

AIRCRAFT—MILITARY
Avro Aircraft Ltd. .. .. 65 ,,
Blackburn & General Aircraft Ltd. .. .. .. 28 ,,
Boeing Airplane Company .. 22 ,,
Boulton Paul Aircraft Ltd. .. 47 ,,
Bristol Aeroplane Co., Ltd., The 39 & 40 ,,
de Havilland Enterprise, The 2 & 30 ,,
Dornier-Werke G.m.b.H. .. 64 ,,
Douglas Aircraft Co. Inc. (U.S.A.) 58 ,,
English Electric Co., Ltd., The 4 & 86 ,,
Fiat S.p.A. .. .. .. 62 ,,
Fokker, N. V. Koninkluke Nederlandse Vliegtuigenfabriek 60 ,,
Folland Aircraft Ltd. .. .. 38 ,,
Handley Page Ltd. .. .. 92 ,,

AIRCRAFT MILITARY
Hawker Siddeley Group Ltd. .. 14 ,,
Martin, The Glenn L. Co. 56 ,,
Hunting Aircraft Ltd. .. 36 ,,
Republic Aviation Corp. (U.S.A.) 48 ,,
Roe, A. V. Canada, Ltd. .. 65 ,,
Scottish Aviation Limited .. 17 ,,
Short Bros. & Harland Ltd. .. 32 ,,
Société Nationale de Constructions Aéronautiques du Nord 72 ,,
Svenska Aeroplan A.B. (Saab Aircraft Co.) .. .. 91 ,,
Vickers-Armstrongs Ltd. .. 70 ,,
Westland Aircraft Ltd... .. 8 ,,

AIRCRAFT—NAVAL
Blackburn & General Aircraft Ltd. .. .. 28 ,,
Boulton Paul Aircraft Ltd. .. 47 ,,
Bristol Aeroplane Co., Ltd., The 39 & 40 ,,
de Havilland Enterprise, The 2 & 30 ,,
Douglas Aircraft Co. Inc. (U.S.A.) 58 ,,


WHIRLWIND HELICOPTERS
ON H.M.S. BULWARK
ALVIS LEONIDES MAJOR ENGINES give the Westland Whirlwind helicopters the increased power which the Royal Navy needs for the anti-submarine duties now being performed by helicopters.
ALVIS
LEONIDES AERO ENGINES
ALVIS LIMITED COVENTRY ENGLAND

CLASSIFIED LIST OF ADVERTISERS—*continued.*

AIRCRAFT NAVAL—*cont.*

	PAGE
Fairey Aviation Co., Ltd., The	34 adv.
Folland Aircraft Ltd.	38 ,,
Hawker Siddeley Group Ltd.	14 ,,
Martin, The Glenn L. Co.	56 ,,
Hunting Aircraft Ltd.	36 ,,
Short Bros. & Harland Ltd.	32 ,,
Svenska Aeroplan A.B. (Saab Aircraft Co.)	91 ,,
Vickers-Armstrongs Ltd.	70 ,,
Westland Aircraft Ltd.	8 ,,

AIRCRAFT—PRIVATE

Blackburn & General Aircraft Ltd.	28 ,,
de Havilland Enterprise, The	2 & 30 ,,
Dornier-Werke, G.m.b.H.	64 ,,
Folland Aircraft Ltd.	38 ,,
Omnipol Ltd. (Czechoslovakia)	52 ,,
Hunting Aircraft Ltd.	36 ,,
Short Bros. & Harland Ltd.	32 ,,
Svenska Aeroplan A.B. (Saab Aircraft Co.)	91 ,,
Vickers-Armstrongs Ltd.	70 ,,
Westland Aircraft Ltd.	8 ,,

AIRCRAFT—RADIO CONTROLLED, GUIDED

M.L. Aviation Co., Ltd.	83 adv.

AIRCRAFT—SEAPLANE

de Havilland Enterprise, The	2 & 30 ,,
Dornier-Werke G.m.b.H.	64 ,,
Folland Aircraft Ltd.	38 ,,
Martin, The Glenn L. Co.	56 ,,
Piper Aircraft Corporation	50 ,,
Short Bros. & Harland Ltd.	32 ,,
Société Nationale de Constructions Aéronautiques du Nord	72 ,,
Vickers-Armstrongs Ltd.	70 ,,

AIRCRAFT—SUPERSONIC

Douglas Aircraft Co. Inc. (U.S.A.)	58 ,,

AIRCRAFT—TRAINING

Boulton Paul Aircraft Ltd.	64 ,,
de Havilland Enterprise, The	2 & 30 ,,
Fairey Aviation Co., Ltd., The	34 ,,
Fiat S.p.A.	62 ,,
Fokker, N. V. Koninkluke Nederlandse Vliegtuigenfabriek	60 ,,
Folland Aircraft Ltd.	38 ,,
Hindustan Aircraft Ltd.	53 ,,
Martin, The Glenn L. Co.	56 ,,
Omnipol Ltd. (Czechoslovakia)	52 ,,
Hunting Aircraft Ltd.	36 ,,
Société Nationale de Constructions Aéronautiques du Nord	72 ,,
Svenska Aeroplan A.B. (Saab Aircraft Co.)	91 ,,
Vickers-Armstrongs Ltd.	70 ,,
Westland Aircraft Ltd.	8 ,,

AIRCRAFT—TRANSPORT

Blackburn & General Aircraft Ltd.	28 ,,
Boeing Airplane Company	22 ,,
Bristol Aeroplane Co., Ltd., The	39 & 40 ,,
de Havilland Enterprise, The	2 & 30 ,,
Dornier-Werke, G.m.b.H.	64 ,,
Douglas Aircraft Co. Inc. (U.S.A.)	58 ,,
Fokker, N. V. Koninkluke Nederlandse Vliegtuigenfabriek	60 ,,
Folland Aircraft Ltd.	38 ,,
Handley Page Ltd.	92 ,,
Martin, The Glenn L. Co.	56 ,,
Omnipol Ltd. (Czechoslovakia)	52 ,,
Hunting Aircraft Ltd.	36 ,,
Roe, A. V. Canada Ltd.	65 ,,
Scottish Aviation Limited	17 ,,
Short Bros. & Harland Ltd.	32 ,,

AIRCRAFT TRANSPORT—*cont.*

	PAGE
Svenska Aeroplan A.B. (Saab Aircraft Co.)	91 adv.
Vickers-Armstrongs Ltd.	70 ,,
Westland Aircraft Ltd.	8 ,,

AIRCRAFT HANGARS

Bellman Hangars Ltd.	103 ,,

AIRCRAFT PISTON ENGINE CYLINDERS—PORUS-KROME PLATED

Fiat S.p.A.	62 ,,

AIRCRAFT PROPELLERS

de Havilland Enterprise, The	2 & 30 ,,
Fairey Aviation Co., Ltd., The	34 ,,
Fiat S.p.A.	62 ,,
Omnipol Ltd. (Czechoslovakia)	52 ,,

AIRFIELD LIGHTING, REMOTE CONTROL SYSTEMS

Standard Telephones & Cables Ltd.	29 ,,

AIRPORT MAINTENANCE EQUIPMENT

M.L. Aviation Co., Ltd.	83 adv.

AIR TRANSPORT CONTRACTING

Scottish Aviation Limited	17 ,,

ALTERNATORS

British Thomson-Houston Co., Ltd., The	41 ,,
English Electric Co., Ltd., The	4 & 86 ,,
Newton Brothers (Derby) Ltd.	69 ,,
Plessey Co., Ltd., The	93 ,,

ALUMINIUM & ALUMINIUM ALLOYS

Hawker Siddeley Group Ltd.	14 adv.
High Duty Alloys Ltd.	37 ,,

AMERICAN SPARES

Fiat S.p.A.	62 ,,

ANTI-VIBRATION MOUNTINGS

Dunlop Rubber Co., Ltd.	98 ,,
Fiat S.p.A.	62 ,,

ARMAMENTS FOR AIRCRAFT

Boulton Paul Aircraft Ltd.	47 ,,
Bristol Aeroplane Co., Ltd., The	39 & 40 ,,
Dunlop Rubber Co., Ltd.	98 ,,
Hispano Suiza	51 ,,
M.L. Aviation Co., Ltd.	83 ,,
Martin-Baker Aircraft Co., Ltd.	96 ,,
Martin, The Glenn L. Co.	56 ,,

ASSEMBLY AND DRILLING JIGS

Cornercroft Ltd.	6 ,,
Fiat S.p.A.	62 ,,

ASSISTED—TAKE-OFF
(Liquid- and solid-propellant rockets for assisted-takeoff, in-flight thrust augmentation, and missile applications)

Fiat S.p.A.	62 ,,

AUTOMATIC TELEPHONY EQUIPMENT

Martin, The Glenn L. Co.	56 ,,

AUTOMATIC VOLTAGE AND CURRENT REGULATORS

Ferranti Ltd.	81 ,,
Newton Brothers (Derby) Ltd.	69 ,,

AVIATION GASOLINE

B.P. Aviation Service	55 ,,
Esso Aviation Products	79 ,,

AVIATION LUBRICATING OIL AND SPECIAL PRODUCTS

B.P. Aviation Service	55 ,,
Esso Aviation Products	79 ,,

AVIATION TURBOFUEL

	PAGE
B.P. Aviation Service	55 adv.
Esso Aviation Products	79 ,,

BALL JOINTS

Amal Ltd.	27 ,,

BALLOONS

Cory Brothers & Company Ltd.	77 ,,

BANNER TARGETS

Cory Brothers & Company Ltd.	77 ,,

BAR, LIGHT METAL

Fiat S.p.A.	62 ,,
High Duty Alloys, Ltd.	37 ,,

BARS, PHOSPHOR BRONZE

Fiat S.p.A.	62 ,,
Yorkshire Engineering Supplies Ltd.	88 ,,

BARS—STAINLESS AND HEAT-RESISTING STEEL

Fiat S.p.A.	62 ,,
Fox, Samuel & Co., Ltd.	97 ,,
Low Moor Alloy Steelworks Ltd.	19 ,,

BEARINGS, BALL & PARALLEL

Fiat S.p.A.	62 ,,

BEARINGS, BRONZE

Fiat S.p.A.	62 ,,
Yorkshire Engineering Supplies Ltd.	88 ,,

BEARINGS, ROLLER, SINGLE AND DOUBLE ROW SELF ALIGNING

Fiat S.p.A.	62 adv.
Geo. Salter & Co. Ltd.	82 ,,
Shafer Bearing Division of Chain Belt Company (U.S.A.)	100 ,,

BELTS, SAFETY

Mills Equipment Co., Ltd., The	88 ,,
Siebe, Gorman & Co., Ltd.	82 ,,

BINOCULARS

Barr & Stroud Ltd.	*Inside back cover*

BLADES, GAS TURBINE, FORGED

Garringtons Ltd.	10 adv.
High Duty Alloys Ltd.	37 ,,
Jessop, William & Sons, Ltd.	95 ,,

BLADES, GAS TURBINE, PRECISION CAST

Fiat S.p.A.	62 adv.
Jessop, William & Sons, Ltd.	95 ,,

BOATS—INFLATABLE

Cory Brothers & Company Ltd.	77 ,,

BOATS, POWER AND SPEED

Vosper Ltd.	42 ,,

BOMBSIGHTS

Sperry Gyroscope Co., Ltd., The	44 ,,
Svenska Aeroplan A.B. (Saab Aircraft Co.)	91 ,,

BRAKE LININGS

Goodyear Tyre & Rubber Co. (Gt. Brit.) Ltd., The	49 ,,

BRAKES FOR AIRCRAFT

Dunlop Rubber Co., Ltd.	98 ,,
Goodyear Tyre & Rubber Co. (Gt. Brit.) Ltd., The	49 ,,

CABIN COOLING (TROPICAL AIRFIELD EQUIPMENT)

M.L. Aviation Co., Ltd.	83 adv.

For over forty years companies of the Hawker Siddeley Group have pioneered and developed aircraft and aero engines. Today the Group is one of the world's leading aircraft designers and builders, whose aircraft and aero engines are proving their excellence in the air forces of the Free World. For this reason, the work of the Hawker Siddeley Group is of fundamental importance to Britain, in an age when freedom and security against aggression depend more and more upon adequate air power.



PIONEER AND WORLD LEADER IN AVIATION

A. V. ROE
GLOSTER
ARMSTRONG WHITWORTH
HAWKER
ARMSTRONG SIDDELEY
HAWKSLEY
HAWKER SIDDELEY NUCLEAR POWER
AIR SERVICE TRAINING
TEMPLEWOOD ENGINEERING
HIGH DUTY ALLOYS *and in Canada:*
AVRO AIRCRAFT
ORENDA ENGINES
CANADIAN STEEL IMPROVEMENT
CANADIAN CAR AND FOUNDRY
CANADIAN STEEL FOUNDRIES

Hawker Siddeley Group

18 St. James's Square, London, S.W.1.

CABIN HEATING PAGE
Marston Excelsior Ltd... .. 85 adv.

CABIN PRESSURISING TEST EQUIPMENT
M.L. Aviation Co., Ltd. .. 83 „

CABLES, AIRCRAFT
Fiat S.p.A. .. .. .. 62 „
Plessey Co., Ltd., The .. 93 „
Standard Telephones and Cables Ltd. .. .. 29 „

CABLES, IGNITION
Fiat S.p.A. .. .. .. 62 „
Plessey Co., Ltd., The .. 93 „

CANVAS
Mills Equipment Co., Ltd., The 88 „

CARBURETTORS
Fiat S.p.A. .. .. .. 62 „
Hobson, H. M., Ltd. .. .. 33 „

CASTINGS, PHOSPHOR BRONZE AND GUN METAL
Yorkshire Engineering Supplies Ltd. .. .. 88 adv.

CASTINGS, SAND, GRAVITY DIE AND PRESSURE DIE, LIGHT METALS
Fiat S.p.A. .. .. .. 62 adv.
Hawker Siddeley Group Ltd. .. 14 „
High Duty Alloys Ltd. .. 37 „
Geo. Salter & Co., Ltd. .. 82 „

CASTINGS—STAINLESS AND HEAT-RESISTING STEEL, CENTRIFUGAL, STATIC AND PRECISION
Fiat S.p.A. .. .. .. 62 adv.
Low Moor Alloy Steelworks Ltd. 19 „

CASTINGS, STEEL
Brown Foundries Co., The David 54 „
Fiat S.p.A. .. .. .. 62 „
Jessop, William & Sons, Ltd. 95 „

CINE COMBAT CAMERAS
Vinten, W. Ltd. .. .. 87 „

CIRCLIPS
Geo. Salter & Co., Ltd. .. 82 „

CLIPS AND FASTENERS, COWLING
Amal Ltd. .. .. .. 27 adv.
Fairey Aviation Co., Ltd., The 34 „

CLIPS FOR LEADS, PIPES, Etc.
Dunlop Rubber Co., Ltd. .. 98 „
Geo. Salter & Co., Ltd. .. 82 „

COMPASSES
Brown, S.G. Ltd. .. .. 85 „
Kollsman Instrument Corporation (U.S.A.) .. .. 102 „
Omnipol Ltd. (Czechoslovakia) 52 „

COMPONENTS
Avco-Lycoming .. .. .. 26 „
Brown, S. G. Ltd. .. .. 85 „
Cornercroft Ltd. .. .. 6 „
Dunlop Rubber Co., Ltd. .. 98 „
Ferranti Ltd. .. .. .. 81 „
Iso-Speedic Co., Ltd., The .. 5 „
Kollsman Instrument Corporation (U.S.A.) .. .. 102 „
Thompson Brothers (Bilston) Ltd. 75 „
Western Manufacturing (Reading) Ltd. .. .. 87 „

CONTROL EQUIPMENT FOR AIRCRAFT
Boulton Paul Aircraft Ltd. .. 47 adv.
Brown S. G. Ltd. .. .. 85 „
Dunlop Rubber Co., Ltd., .. 98 „

CONTROL EQUIPMENT FOR AIRCRAFT—*cont.* PAGE
Fairey Aviation Co., Ltd., The 34 adv.
Hobson, H. M. Ltd. .. .. 33 „
Iso-Speedic Co., Ltd., The .. 5 „
Kollsman Instrument Corporation (U.S.A.) .. .. 102 „
M.L. Aviation Co., Ltd. .. 83 „
Omnipol Ltd. (Czechoslovakia) 52 „

CONTROL JOINTS, BALL & ROLLER
Amal Ltd. .. .. .. 27 adv.

CONTROLS, COCKPIT
Dunlop Rubber Co., Ltd. .. 98 „
Hobson, H. M., Ltd. .. .. 33 „

COOLERS, OIL
Marston Excelsior Ltd. .. 85 „

COOLERS, WATER
Heenan & Froude Ltd. .. 24 „
Marston Excelsior Ltd... .. 85 „

COVERS, AIRCRAFT WEATHER
Cory Brothers & Company Ltd. 77 „

CRANKSHAFTS
Jessop, William & Sons, Ltd. 95 „

CRIMPING TOOLS FOR SOLDERLESS JOINTS
Plessey Co., Ltd., The .. 93 „

DE-ICING EQUIPMENT
Dunlop Rubber Co., Ltd. .. 98 „
Western Manufacturing (Reading) Ltd. .. .. 87 „

DINGHIES AND RAFTS
Cory Brothers & Company Ltd. 77 „
Siebe, Gorman & Co., Ltd. .. 82 „

DISCS, GAS TURBINE, FORGED
Fiat S.p.A. .. .. .. 62 „
Jessop, William & Sons, Ltd. 95 „

DISCS, GAS TURBINE, DROP STAMPED
Fiat S.p.A. .. .. .. 62 „
Jessop, William & Sons, Ltd. 95 „

DOPES
Cellon Ltd. .. .. .. 43 „

DRILLING MACHINES
Edwards, F. J., Ltd. .. .. 9 „
Fiat S.p.A. .. .. .. 62 „

DRILLS, PORTABLE, PNEUMATIC AND ELECTRIC
Desoutter Brothers, Ltd. .. 16 adv.

DYNAMIC BALANCING MACHINES
Sperry Gyroscope Co., Ltd., The 44 adv.

DYNAMOMETERS, ELECTRICAL EDDY-CURRENT
Heenan & Froude, Ltd. .. 24 „

DYNAMOMETERS, HYDRAULIC AND ELECTRIC
Heenan & Froude, Ltd. .. 24 adv.

EJECTION SEATS
Martin-Baker Aircraft Co., Ltd. 96 „

ELECTRIC AUXILIARIES
British Thomson-Houston Co., Ltd., The .. .. .. 41 „
Brown, S. G. Ltd. .. .. 85 „
Plessey Co., Ltd., The .. 93 „
Western Manufacturing (Reading) Ltd. .. .. 87 „

ELECTRICAL EQUIPMENT
British Thomson-Houston Co., PAGE
Ltd., The .. .. .. 41 adv.
Dunlop Rubber Co., Ltd. .. 98 „
Ferranti Ltd. .. .. .. 81 „
Fiat S.p.A. .. .. .. 62 „
M.L. Aviation Co., Ltd. .. 83 „
Newton Bros. (Derby) Ltd. .. 69 „
Plessey Co., Ltd., The .. 93 „
Western Manufacturing (Reading) Ltd. .. .. 87 „

ELECTRICAL OVERHAUL
Western Manufacturing (Reading) Ltd. .. .. 87 „

ELECTRICAL PLANT
British Thomson-Houston Co., Ltd., The .. .. .. 41 „
Newton Bros. (Derby) Ltd. .. 69 „

ELECTRICAL PLUGS AND SOCKETS (WATERPROOF)
M.L. Aviation Co., Ltd. .. 83 adv.

ELECTRONIC EQUIPMENT
Avco-Lycoming .. .. 26 „
Boulton Paul Aircraft Ltd. .. 47 „
Ferranti Ltd. .. .. .. 81 „
Fiat S.p.A. .. .. .. 62 „
M.L. Aviation Co., Ltd. .. 83 „
Martin, The Glenn L. Co. .. 56 „
M.S.S. Recordings Co. Ltd. .. 84 „

ELECTRONICS AND GUIDANCE
Avco-Lycoming .. .. 26 „
Brown, S. G. Ltd. .. .. 85 „
Ferranti Ltd. .. .. .. 81 „
Kollsman Instrument Corporation (U.S.A.) .. .. 102 „
M.S.S Recordings Co. Ltd. .. 84 „

ENGINES, AUXILIARY
A.B.C. Motors Ltd. .. .. 88 „
de Havilland Enterprise, The 2 & 30 „
Avco-Lycoming .. .. .. 26 „

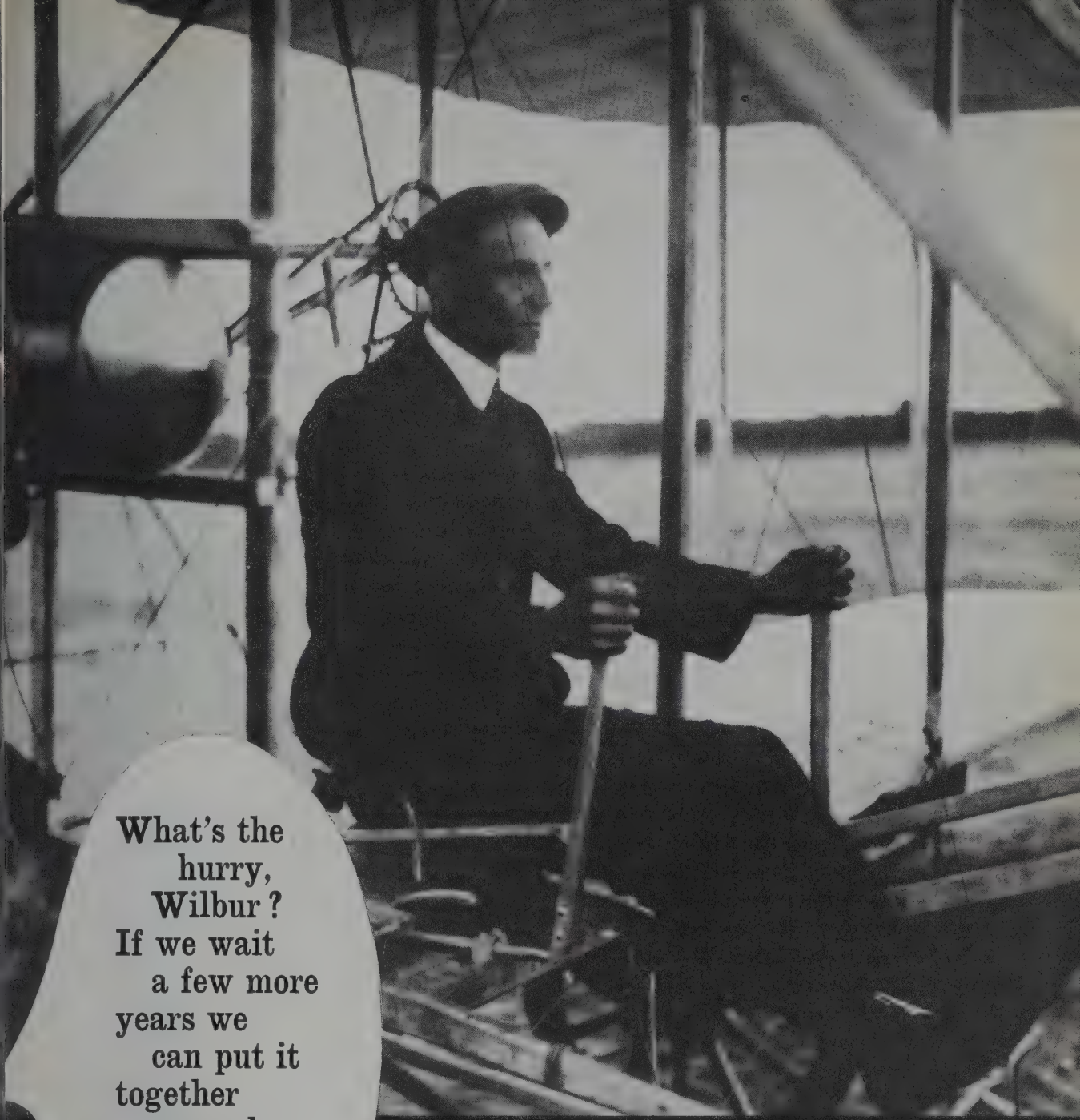
ENGINE PARTS FABRICATION
Fiat S.p.A. .. .. .. 62 „
Western Manufacturing (Reading) Ltd. .. .. 87 „

ENGINE SCREENING HARNESS
Plessey Co., Ltd., The .. 93 adv.

ENGINE STARTING EQUIPMENT
A.B.C. Motors Ltd. .. .. 88 adv.
British Thomson-Houston Co., Ltd., The .. .. .. 41 „
Plessey Co., Ltd., The .. 93 „
Standard Telephones and Cables Ltd. .. .. .. 29 „

ENGINE TESTING EQUIPMENT
Heenan & Froude Ltd... .. 24 „
Hobson, H. M., Ltd. .. 33 „
Plessey Co., Ltd., The.. .. 93 „
Standard Telephones & Cables Ltd. .. .. 29 „

ENGINES—AIRCRAFT
Blackburn & General Aircraft Ltd. .. .. 28 „
Bristol Aeroplane Co., Ltd., The .. .. .. 39 & 40 „
de Havilland Enterprise, The 2 & 30 „
Fiat S.p.A. .. .. .. 62 „



What's the hurry, Wilbur? If we wait a few more years we can put it together properly with Desoutter power tools.

Every British aircraft flying today (and quite a few others in the world) have been assembled with the help of Desoutter Power Tools.

SOUTTER BROS. LTD., The Hyde, Hendon, London, N.W.9. Telephone: Colindale 6346 (5 lines) Telegrams: Despnuco, Hyde, Lond



Anywhere in the World is an Airfield..!

A hundred yards, or so, of reasonably level ground is all that the Twin Pioneer needs. It can land at bicycle speed in 100 yards; can take off in 85. With its unlimited utility and 'put-down-any-place' performance, the Twin Pioneer can carry the countless benefits of air transport simply and cheaply, to anywhere in the world.

16 PASSENGER

Twin Pioneer

POWERED BY ALVIS LEONIDES ENGINES
FITTED WITH DE HAVILLAND PROPELLERS

SCOTTISH AVIATION PRESTWICK AIRPORT · AYRSHIRE Phone: Prestwick 79888

CLASSIFIED LIST OF ADVERTISERS—*continued.*

ENGINES—AIRCRAFT—*cont.* PAGE
Hawker Siddeley Group Ltd. 14 adv.
Hispano Suiza .. .. .. 51 „
Napier, D., & Son, Ltd. *Inside front cover*
Omnipol Ltd. (Czechoslovakia) 52 adv.
Orenda Engines Ltd. .. .. 73 „

ENGRAVING
Vosper Ltd. .. .. .. 42 „

EQUIPMENT FOR AIRCRAFT
Brown, S. G. Ltd. .. .. 85 „
Dunlop Rubber Co., Ltd. .. 98 „
Ferranti Ltd. .. .. .. 81 „
Kidde, Walter Co., Ltd., The 71 „
M.L. Aviation Co., Ltd. .. 83 „
Mills Equipment Co., Ltd., The 88 „
Plessey Co., Ltd., The .. 93 „
Siebe, Gorman & Co., Ltd. .. 82 „
Vickers-Armstrongs Ltd. .. 70 „

EQUIPMENT, FUEL INJECTION
Fiat S.p.A. .. .. .. 62 „
Hobson, H. M. Ltd. .. .. 33 „

EXPERIMENTAL ASSEMBLIES
Brown, S. G. Ltd. .. .. 85 „
Cornercroft Ltd. .. .. 6 „

EXTRUSIONS, LIGHT METAL
Fiat S.p.A. .. .. .. 62 „
Hawker Siddeley Group Ltd. .. 14 „
High Duty Alloys Ltd. .. 37 „
Low Moor Fine Steels Ltd. .. 19 „

EXTRUSIONS, STEEL
Low Moor Fine Steels Ltd. .. 19 „

FAIRINGS
Burnley Aircraft Products Ltd. 66 „
Marston Excelsior Ltd... .. 85 „

FASTENERS
Geo. Salter & Co., Ltd. .. 82 „

FEATHERING DEVICE, AUTOMATIC, FOR PROPELLERS
Martin-Baker Aircraft Co., Ltd. 96 adv.

FILLING VALVES
Dunlop Rubber Co., Ltd. .. 98 „

FILTERS, AIR
Automotive Products Co., Ltd. 20 „
Dunlop Rubber Co., Ltd. .. 98 „
Fiat S.p.A. .. .. .. 62 „

FILTERS, FUEL AND OIL
A.B.C. Motors Ltd. .. .. 88 „
Amal Ltd. .. .. .. 27 „
Automotive Products Co., Ltd. 20 „
Fiat S.p.A. .. .. .. 62 „

FINISHED MACHINED PARTS IN PHOSPHOR BRONZE AND GUN METAL
Cornercroft Ltd. .. .. 6 „
Fiat S.p.A. .. .. .. 62 „
Yorkshire Engineering Supplies Ltd. .. .. 88 „

FINISHES FOR AIRCRAFT
Cellon Ltd. .. .. .. 43 „
Titanine Ltd. .. .. .. 78 „

FIRE EXTINGUISHERS
Kidde, Walter Co. Ltd., The 71 „
Siebe, Gorman & Co., Ltd. .. 82 „

FIRE FIGHTING VEHICLES
Fiat S.p.A. .. .. .. 62 „
Kidde, Walter Co., Ltd., The 71 „

FLAME TRAPS
Amal Ltd. .. .. .. 27 „

FLEXIBLE FUEL TANKS PAGE
Marston Excelsior Ltd. .. 85 adv.

FLIGHT SIMULATORS
Air Trainers Ltd. .. .. 84 „
Redifon Ltd. .. .. 99 „

FLOTATION GEAR
Cory Brothers & Company Ltd. 77 „
Kidde, Walter Co., Ltd., The 71 „
Westland Aircraft Ltd. .. 8 „

FLYING CLOTHING
G.Q. Parachute Co., Ltd., The 68 „
Siebe, Gorman & Co., Ltd. .. 82 „

FOAM DISCHARGING VEHICLES
Fiat S.p.A. .. .. .. 62 „

FOLDING AND BENDING MACHINES
Edwards, F. J., Ltd. .. .. 9 adv.

FORGINGS, DROP
Fiat S.p.A. .... 62 „
Garringtons Ltd. .. .. 10 „
Hawker Siddeley Group Ltd. .. 14 „
Jessop, William & Sons, Ltd. 95 „

FORGINGS, LIGHT METAL
Fiat S.p.A. .. .. .. 62 „
Garringtons Ltd. .. .. 10 „
Hawker Siddeley Group Ltd. .. 14 „
High Duty Alloys Ltd. .. 37 „

FORGINGS, STEEL
Fiat S.p.A. .. .. .. 62 „
Garringtons Ltd. .. .. 10 „
Jessop, William & Sons, Ltd. 95 „
Low Moor Alloy Steelworks Ltd. 19 „

FUELS
BP Aviation Service .. .. 55 „
Esso Aviation Products .. 79 „
Fiat S.p.A. .. .. .. 62 „

FUEL COCKS
Vickers-Armstrongs Ltd. .. 70 „

FUEL HOSE ASSEMBLIES
Boorn, Thomas & Co., Ltd. .. 31 „

FUEL PUMPS
A.B.C. Motors Ltd. .. .. 88 „
Hobson, H. M. Ltd. .. .. 33 „
Plessey Co., Ltd., The .. 93 „
Siebe Gorman & Co., Ltd. .. 82 „

FUEL PUMPS (LIFT)
Amal Ltd. .. .. .. 27 „

FUELLING SERVICE
BP Aviation Service .. .. 55 „
Esso Aviation Products .. 79 „

FURNISHINGS FOR AIRCRAFT CABINS
Vickers-Armstrongs Ltd. .. 70 „
Scottish Aviation Limited .. 17 „

FUSE AND TERMINAL BLOCKS
Plessey Co., Ltd., The .. 93 „

GAS MASKS
Siebe, Gorman & Co., Ltd. .. 91 „

GAS TURBINES
Avco-Lycoming .. .. 26 „
Blackburn & General Aircraft Ltd. .. .. 28 „
Boeing Airplane Company .. 22 „
Bristol Aeroplane Co., Ltd., The 39 & 40 „
de Havilland Enterprise, The 2 & 30 „
Hawker Siddeley Group Ltd. .. 14 „
Napier, D., & Son Ltd. *Inside front cover*
Orenda Engines Ltd. .. .. 73 adv.

GAS TURBINES, EQUIPMENT AND ACCESSORIES FOR PAGE
Burnley Aircraft Products Ltd. 66 adv.
Hobson, H. M., Ltd. .. .. 33 „
Jessop, William & Sons, Ltd. 95 „
Orenda Engines Ltd. .. .. 73 „
Plessey Co., Ltd., The .. 93 „
Western Manufacturing (Reading) Ltd. .. .. 87 „

GASKETS
Dunlop Rubber Co., Ltd. .. 98 „

GAUGES
Hobson, H. M. Ltd. .. .. 33 „
Plessey Co., Ltd., The .. 93 „

GAUGES, TYRE PRESSURE
Dunlop Rubber Co., Ltd. .. 98 „

GEARS
Brown, S. G. Ltd. .. .. 85 „

GENERATORS FOR AIRCRAFT
British Thomson-Houston Co., Ltd., The .. .. .. 44 „
English Electric Co., Ltd., The 4 & 86 „
Newton Bros. (Derby) Ltd. .. 69 „

GOVERNORS, SPEED
Iso-Speedic Co., Ltd., The .. 5 „

GRINDING MACHINES
Edwards, F. J., Ltd. .. .. 9 „

GROUND, WORKSHOP AND HANGAR EQUIPMENT
H.M.L. (Engineering) Ltd. .. 35 adv.

GUIDED MISSILES
Brown, S. G., Ltd. .. .. 85 „
Douglas Aircraft Co. Inc. (U.S.A.) 58 „
Martin, The Glenn L. Co. .. 56 „
M.S.S. Recordings Co. Ltd. .. 84 „
Thompson Brothers (Bilston) Ltd. 75 „

GUILLOTINES
Edwards, F. J., Ltd. .. .. 9 „

GUN FEEDS
Martin-Baker Aircraft Co., Ltd. 96 „

GUNNERY TRAINING APPARATUS
M.L. Aviation Co., Ltd. .. 83 adv.
Martin, The Glenn L. Co. .. 56 „

HAND CREAM (INDUSTRIAL)
Cellon Ltd. .. .. .. 43 „

HANGARS
Bellman Hangars Ltd... 103 „

HANGERS, HELICOPTER, INFLATABLE
Cory Brothers & Company Ltd. 77 adv.

HANGER TEST STANDS
Heenan & Froude Ltd. .. 24 „

HARNESS, SAFETY
G.Q. Parachute Co., Ltd., The 68 „
M.L. Aviation Co., Ltd. .. 83 „
Mills Equipment Co., Ltd., The 88 „
Siebe, Gorman & Co., Ltd. .. 82 „

HEADPHONES
Brown, S. G. Ltd. .. .. 85 „

HEAT-RESISTING ALLOYS
Brown Foundries Co., The David 54 „
Fiat S.p.A. .. .. .. 62 „
Jessop, William & Sons, Ltd. 95 „

HELICOPTERS—COMMERCIAL
Bristol Aeroplane Co., Ltd. The 39 & 40 „
Fiat S.p.A. .. .. .. 62 „
Omnipol Ltd. (Czechoslovakia) 52 „
Westland Aircraft Ltd. .. 8 „

Special Steels

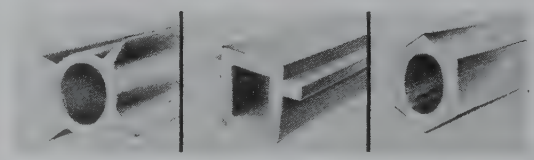
FOR THE AIRCRAFT INDUSTRY

LOW MOOR
ALLOY STEELWORKS LIMITED



Specified by many world famous Aircraft and Aero-Engine Manufacturers, the Alloy and Special Steels produced by Low Moor Alloy Steelworks are specially made and tested to Aircraft standards.

Steel Extrusions



Steel Extrusions by Low Moor Fine Steels Ltd. are produced to an exacting quality, eliminate many costly machine processes, and are used extensively in Aircraft Manufacture.

LOW MOOR
FINE STEELS LIMITED

BRADFORD YORKSHIRE ENGLAND

Telephone: Bradford 77331 (9 Lines)

19 adv.

HELICOPTERS—MILITARY

	PAGE
Bristol Aeroplane Co., Ltd. The	39 & 40 adv.
Fiat S.p.A.	62 ,,
Omnipol Ltd. (Czechoslovakia)	52 ,,
Westland Aircraft Ltd. ..	8 ,,

HIGH ALTITUDE TESTING PLANT

Martin, The Glenn L. Co. ..	56 adv.

HIGH ALTITUDE PRESSURE SUITS

Siebe, Gorman & Co., Ltd. ..	82 adv.

HIGH FATIGUE AIRCRAFT BOLTS

Fiat S.p.A.	62 adv.

HIGH SPEED RECORDING CAMERAS

Brown, S. G. Ltd.	85 ,,

HIGH SPEED RESEARCH CAMERAS

Vinten, W. Ltd.	87 adv.

HIGH TEMPERATURE MATERIALS

Fiat S.p.A.	62 adv.
Low Moor Alloy Steelworks Ltd.	19 ,,
Wiggin, Henry & Co., Ltd.	101 ,,

HOSE AND COUPLINGS, HYDRAULIC AND FUEL

Automotive Products Co., Ltd.	20 adv.
Dunlop Rubber Co., Ltd. ..	98 ,,

HYDRAULIC EQUIPMENT

Automotive Products Co., Ltd.	20 ,,
Boulton Paul Aircraft Ltd. ..	47 ,,
Dunlop Rubber Co., Ltd. ..	98 ,,
Fairey Aviation Co., Ltd., The	34 ,,
Goodyear Tyre & Rubber Co. (Great Britain) Ltd., The ..	49 ,,
H.M.L. (Engineering) Ltd. ..	35 ,,
Hobson, H. M. Ltd.	33 ,,
Integral Ltd.	86 ,,
Plessey Co., Ltd., The ..	93 ,,

HYDRAULIC MACHINES AND PRESSES

Edwards, F. J., Ltd.	9 adv.

HYDRAULIC PRESSURE PUMPS

Goodyear Tyre & Rubber Co. (Great Britain) Ltd., The ..	49 ,,
H.M.L. (Engineering) Ltd. ..	35 ,,
Integral Ltd.	86 ,,
Plessey Co., Ltd., The ..	93 ,,

HYDRAULIC TEST UNITS, MOBILE AND STATIC

H.M.L. (Engineering) Ltd. ..	35 ,,

INDUSTRIAL AND WORKSHOP BUILDINGS

Bellman Hangars Ltd... ..	103 ,,

IGNITION ACCESSORIES

British Thomson-Houston Co., Ltd., The	41 ,,
Plessey Co., Ltd., The ..	93 ,,

INSTRUMENTATION CAMERAS

Vinten, W. Ltd.	87 ,,

INSTRUMENTS, AIRCRAFT

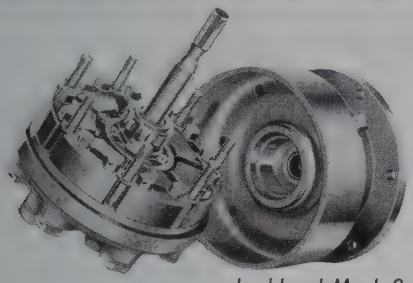
Avco-Lycoming	26 ,,
Brown, S. G. Ltd.	85 ,,
Ferranti Ltd.	81 ,,
Fiat S.p.A.	62 ,,
Kollsman Instrument Corporation (U.S.A.)	102 ,,
Omnipol Ltd. (Czechoslovakia)	52 ,,
Siebe, Gorman & Co., Ltd. ..	82 ,,
Sperry Gyroscope Co., Ltd., The	44 ,,

INSTRUMENTS, BLIND FLYING

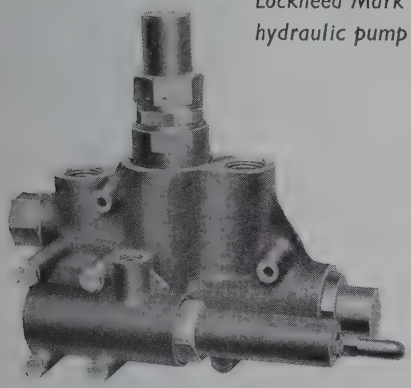
Kollsman Instrument Corporation (U.S.A.)	102 ,,
Sperry Gyroscope Co., Ltd., The	44 ,,

INSTRUMENTS, ELECTRONIC

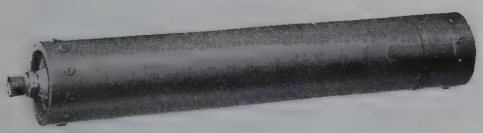
Avco-Lycoming	26 adv.
Boulton Paul Aircraft Ltd. ..	47 ,,
Brown, S. G. Ltd.	85 ,,
Kollsman Instrument Corporation (U.S.A.)	102 ,,



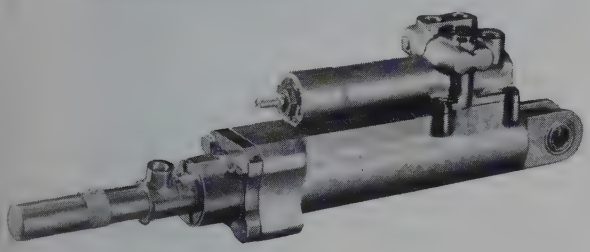
Lockheed Mark 9 hydraulic pump



Lockheed silent cut-out valve



Lockheed accumulator



Lockheed 'Servodyne'

Complete hydraulic systems for aircraft

The famous Lockheed Mark 7, 8 and 9 hydraulic pumps are used to actuate the hydraulic systems of many important aircraft. The Lockheed silent cut-out valve and the Lockheed accumulator are other important units used in conjunction with the Lockheed pump.

'Servodyne' powered flying controls

These fine units are backed by more than 14 years of continuous flying service in the air. They are used on many of the world's finest aircraft for elevators, ailerons and rudder controls.

Undercarriages

Lockheed undercarriages and retraction jacks are made in a wide range of types and sizes, for aircraft of every type.

AUTOMOTIVE PRODUCTS COMPANY LTD., LEAMINGTON SPA, WARWICKSHIRE, ENGLAND

Regd. Trade Marks: Lockheed, 'Servodyne'

ALL-BRITISH

Lockheed

FOREMOST IN HIGH-PRECISION HYDRAULICS

INSTRUMENTS, NAVIGATION

	PAGE
Avco-Lycoming	26 adv.
Brown, S. G. Ltd.	85 „
Ferranti Ltd.	81 „
Kollsman Instrument Corporation (U.S.A.)	102 „
Omnipol Ltd. (Czechoslovakia)	52 „
Sperry Gyroscope Co., Ltd., The	44 „

INSTRUMENTS, PRECISION

Barr & Stroud Ltd.	*(Inside Back Cover)*
Brown, S. G. Ltd.	85 adv.
Ferranti Ltd.	81 „
Iso-Speedic Co. Ltd., The	5 „
Kollsman Instrument Corporation (U.S.A.)	102 „
Plessey Co., Ltd., The	93 „
Sperry Gyroscope Co., Ltd., The	44 „

INSTRUMENTS, TEST EQUIPMENT

Amal Ltd.	27 adv.
Bryans Aeroquipment Ltd.	45 „
Hobson, H. M. Ltd.	33 „
Kollsman Instrument Corporation (U.S.A.)	102 „
Omnipol Ltd. (Czechoslovakia)	52 „
Plessey Co., Ltd., The	93 „

INSURANCE, AERO

British Aviation Insurance Co., Ltd., The	67 „

INTERCOMMUNICATION EQUIPMENT

Brown, S. G. Ltd.	85 „

INTERCOOLERS

Marston Excelsior Ltd.	85 „

JET CALIBRATING MACHINES

Amal Ltd.	27 „

JET ENGINE COMBUSTION EQUIPMENT, MANUFACTURE OF

Burnley Aircraft Products Ltd.	66 „

JET ENGINE COMBUSTION EQUIPMENT, REPAIR OF

Burnley Aircraft Products Ltd.	66 „

JET ENGINE TEST PLANT

Avco-Lycoming	26 „
Heenan & Froude Ltd.	24 „
Hispano Suiza	51 „

JET PROPULSION ENGINES

Blackburn & General Aircraft Ltd.	28 „
Bristol Aeroplane Co., Ltd., The	39 & 40 „
de Havilland Enterprise, The	2 & 30 „
Fiat S.p.A.	62 „
Hispano Suiza	51 „

JETTISONABLE CANOPY MECHANISMS

M.L. Aviation Co., Ltd.	83 „

JOINTING MATERIAL

Cellon Ltd.	43 „

LACQUERS

Cellon Ltd.	43 „
Fiat S.p.A.	62 „

LAMINATES

Fiat S.p.A.	62 „
Marston Excelsior Ltd.	85 „

LAMPS—AIRSTRIP, OBSTRUCTION (VEHICLE)

Butlers Ltd.	59 adv.

LAMPS, COCKPIT

	PAGE
British Thomson-Houston Co., Ltd., The	41 adv.
Butlers Ltd.	59 „

LAMPS FOR GROUND STATIONS

Butlers Ltd.	59 „

LAMPS, INSPECTION

British Thomson-Houston Co., Ltd., The	41 „
Butlers Ltd.	59 „

LATHES

Edwards, F. J., Ltd.	9 „
Fiat S.p.A.	62 „

LATHES, CAPSTAN

Edwards, F. J., Ltd.	9 „

LATHES, TURRET

Edwards, F. J., Ltd.	9 „

LAUNCHES FOR AIRCRAFT STATIONS

Vosper Ltd.	42 adv.

LIFE RAFTS

Cory Brothers & Company Ltd.	77 „

LIFE SAVING EQUIPMENT

Cory Brothers & Company Ltd.	77 „
G.Q. Parachute Co., Ltd., The	68 „
Kidde, Walter Co., Ltd., The	71 „
M.L. Aviation Co., Ltd.	83 „
Martin-Baker Aircraft Co., Ltd.	96 „
Siebe, Gorman & Co., Ltd.	82 „

LIFE SAVING JACKETS

Cory Brothers & Company Ltd.	77 „
Kidde, Walter Co., Ltd., The	71 „
Siebe, Gorman & Co., Ltd.	82 „

LIGHTS, AIRCRAFT

Butlers Ltd.	59 „

LIGHTS, CABIN

Butlers Ltd.	59 „

LIGHTS, IDENTIFICATION

Butlers Ltd.	59 „

LIGHTS, LANDING

Butlers Ltd.	59 „

LIGHTS, NAVIGATION

Butlers Ltd.	59 „

LINE TELEPHONY EQUIPMENT

Brown, S. G. Ltd.	85 „

LININGS, BRAKE

Goodyear Tyre & Rubber Co. (Gt. Brit.) Ltd., The	49 „

LUBRICANTS

Esso Aviation Products	79 „
Fiat S.p.A.	62 „

MACHINE TOOLS

Edwards, F. J., Ltd.	9 „
Fiat S.p.A.	62 „

MACHINING

A.B.C. Motors Ltd.	88 „
Cornercroft Ltd.	6 „

MAGNETIC INDICATORS

Plessey Co., Ltd., The	93 „

MAGNETIC RECORDING EQUIPMENT

M.S.S. Recordings Co. Ltd.	84 adv.

MAGNETOS

British Thomson-Houston Co., Ltd., The	41 „
Fiat S.p.A.	62 „

MAGNETS, INSTRUMENT

	PAGE
Jessop, William & Sons, Ltd.	95 adv.

MARINE ENGINES

Fiat S.p.A.	62 „
Napier, D., & Son, Ltd.	*Inside front cover*
Vosper Ltd.	42 adv.

METAL FITTINGS

Burnley Aircraft Products Ltd.	59 „
Mills Equipment Co., Ltd., The	88 „
Western Manufacturing (Reading) Ltd.	87 „

METAL/RUBBER JOINTING

Dunlop Rubber Co., Ltd.	98 „

METERING LUBRICATION PUMPS

Plessey Co., Ltd., The	93 adv.

METERS, FLOW

Amal Ltd.	27 „

MICRO-WAVE TEST EQUIPMENT

Ferranti Ltd.	81 adv.

MILLING MACHINES

Edwards, F. J., Ltd.	9 „
Fiat S.p.A.	62 „

MOTOR CARS

Alvis Ltd.	12 „
Bristol Aeroplane Co., Ltd., The	39 & 40 „
Fiat S.p.A.	62 „
Hawker Siddeley Group Ltd.	14 „
Svenska Aeroplan A.B. (Saab Aircraft Co.)	91 „

MOTORS, ELECTRIC

British Thomson-Houston Co., Ltd., The	41 „
Brown, S. G. Ltd.	85 „
English Electric Co., Ltd., The	4 & 86 „
Fiat S.p.A.	62 „
Newton Brothers (Derby) Ltd.	69 „
Plessey Co., Ltd., The	93 „
Western Manufacturing (Reading) Ltd.	87 „

NAME PLATES

Barr & Stroud Ltd.	*Inside back cover*
Vosper Ltd.	42 adv.

NIBBLING MACHINES

Desoutter Brothers Ltd.	16 „
Edwards, F. J., Ltd.	9 „

NIMONIC ALLOYS

Fiat S.p.A.	62 „
Wiggin, Henry & Co., Ltd.	101 „

OILS

Esso Aviation Products	79 „
Fiat S.p.A.	62 „

OIL SEALS

Dunlop Rubber Co., Ltd.	98 „

OPTICAL GUNSIGHTS

Avco-Lycoming	26 „
Barr & Stroud Ltd.	*(Inside Back Cover)*
Kollsman Instrument Corporation (U.S.A.)	102 adv.

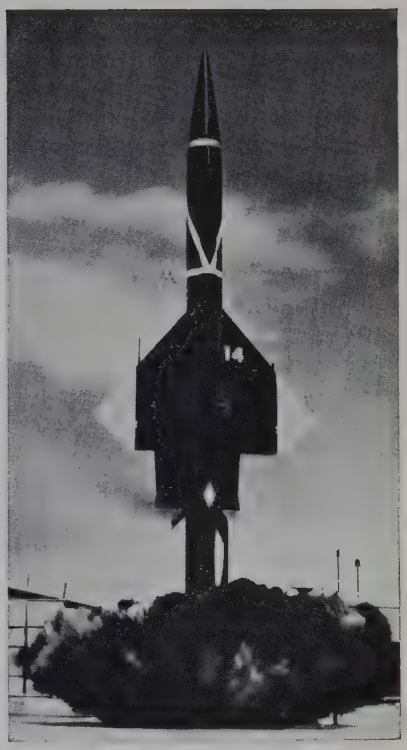
ORDNANCE ROCKETS

Fiat S.p.A.	62 „

OXYGEN APPARATUS

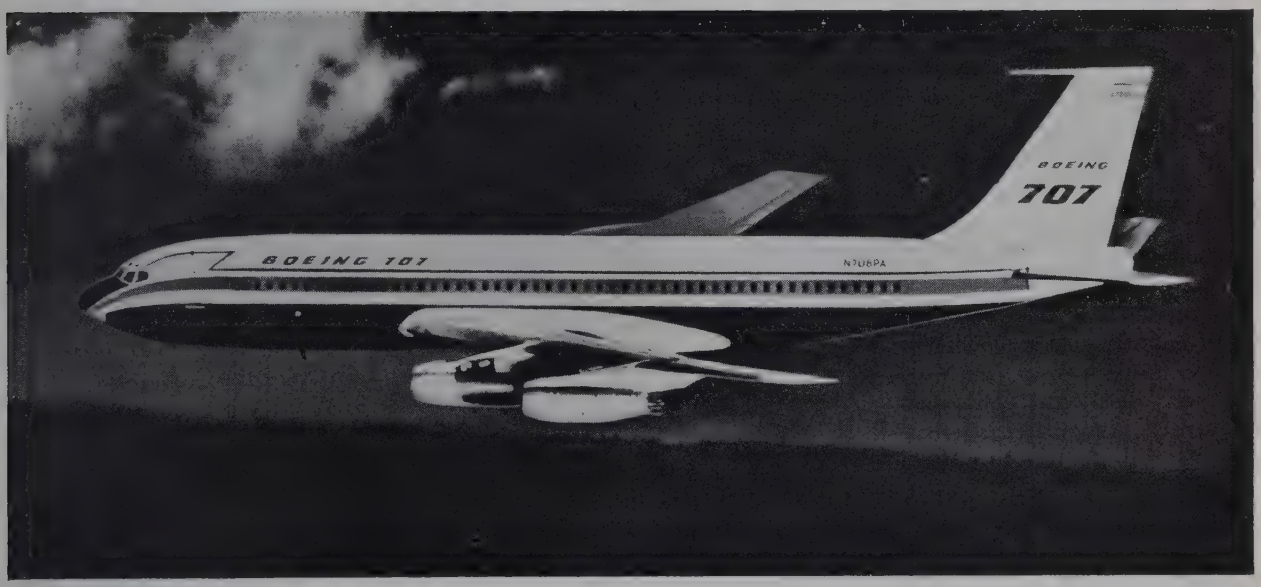
British Oxygen Aro Equipment Ltd.	90 „
Kidde, Walter Co., Ltd., The	71 „
Siebe, Gorman & Co., Ltd.	82 „





BOEING B-52, front-line nuclear weapons carrier of the U.S. Strategic Air Command. Holds non-stop round-the-world record: 45 hours, 19 minutes. Advanced B-52 will carry supersonic air-to-ground missiles. Advantages: accurate long-range guidance, mission recallability, plus supersonic missile speed at "hot end" of target approach.

BOEING BOMARC IM-99 supersonic long-range defence missile, is launched automatically, and can carry atomic warhead. Bomarcs can be fired in multiple, and directed to intercept individual bombers or air-breathing missiles of a mass attacking force. In volume production for U.S. Air Defence Command.



SWIFT, SWEPT-WING BOEING 707 jetliner, on order by leading world airlines, goes into service this year. Carries up to 160 passengers at 600 miles an hour. Backed by experience Boeing gained building more than 1600 large multi-jet aircraft.



JET TRANSPORT-TANKER, the Boeing KC-135, in volume production, and in service with U.S. Air Force. KC-135's primary function is aerial refueling of Strategic Air Command's B-47s and B-52s, thus extending the range and effectiveness of these multi-jet bombers. KC-135s hold the world's non-stop jet transport record.

BOEING

PAINT REMOVER PAGE
Cellon Ltd. .. .. .. 43 adv.

PAINTS AND VARNISHES
Cellon Ltd. .. .. .. 43 „
Fiat S.p.A. .. .. .. 62 „
Titanine Ltd. .. .. .. 78 „

PARACHUTES, LIFE SAVING
G.Q. Parachute Co., Ltd., The 68 „
Irving Air Chute of Great Britain Ltd., The .. .. .. 76 „
Omnipol Ltd. (Czechoslovakia) 52 „

PARACHUTES, SUPPLIES DROPPING
G.Q. Parachute Co., Ltd., The 68 adv.
Irving Air Chute of Great Britain Ltd., The .. .. .. 76 „

PARACHUTES, TROOP LANDING
G.Q. Parachute Co., Ltd., The 68 „
Irving Air Chute of Great Britain Ltd., The .. .. .. 76 „

PETROL
BP Aviation Service .. .. 55 „
Esso Aviation Products .. 79 „
Fiat S.p.A. .. .. .. 62 „

PHOTOGRAPHIC EQUIPMENT
Vinten, W. Ltd. .. .. 87 „

PINS—QUICK RELEASE
Western Manufacturing (Reading) Ltd. .. .. 87 „

PLASTIC FABRICATIONS
Fairey Aviation Co., Ltd., The 34 „
Fiat S.p.A. .. .. .. 62 „
Folland Aircraft Ltd. .. 38 „
Kidde, Walter Co., Ltd., The 71 „
Vosper Ltd. .. .. .. 42 „

PLASTIC MOULDINGS
Cornercroft Ltd. .. .. 6 „
Fairey Aviation Co., Ltd., The 34 „
Folland Aircraft Ltd. .. 38 „
Vosper Ltd. .. .. .. 42 „
Western Manufacturing (Reading) Ltd. .. .. 87 „

PLASTICS, TRANSPARENT
Fairey Aviation Co., Ltd., The 34 „
Fiat S.p.A. .. .. .. 62 „
Folland Aircraft Ltd. .. 38 „

PLUGS AND SOCKETS
Plessey Co., Ltd., The .. 93 „
Western Manufacturing .. (Reading) Ltd. .. 87 „

POWER CONTROLS FOR AIRCRAFT
Boulton Paul Aircraft Ltd. .. 47 adv.

POWER PRESSES
Edwards, F. J., Ltd. .. .. 9 „

PRECISION WORK
A.B.C. Motors Ltd. .. .. 88 „
Brown, S. G. Ltd. .. .. 85 „
Cornercroft Ltd. .. .. 6 „
Iso-Speedic Co., Ltd., The .. 5 „
Plessey Co., Ltd., The .. 93 „
Short Bros. & Harland Ltd. .. 32 „

PREFABRICATED ALUMINIUM ALLOY STRUCTURES
Cornercroft Ltd. .. .. 6 „

PRE-FORMED WIRING ASSEMBLIES
Plessey Co., Ltd., The .. 93 adv.

PREPACK DINGHY STOWAGE
Kidde Walter Co., Ltd., The 71 „

PREPACKAGING PAGE
Geo. Salter & Co., Ltd. .. 82 adv.

PRESSURE REGULATING VALVES, FLUIDS AND GASES
Amal Ltd. .. .. .. 27 „
Dunlop Rubber Co., Ltd. .. 98 „
Integral Ltd. .. .. .. 86 „
Kidde, Walter Co., Ltd., The 71 „
Plessey Co., Ltd., The .. 93 „
Siebe, Gorman & Co., Ltd. .. 82 „

PRESS TOOL SETS (STANDARDISED)
Desoutter Brothers Ltd. .. 16 adv.

PRESS WORK
Burnley Aircraft Products Ltd. 66 „
Cornercroft Ltd. .. .. 6 „
Folland Aircraft Ltd. .. 38 „
Plessey Co., Ltd., The .. 93 „
Short Bros. & Harland Ltd. .. 32 „
Western Manufacturing (Reading) Ltd. .. .. 87 „

PROPELLER TEST STANDS
Heenan & Froude Ltd. .. 24 „

PROPELLER HUBS
de Havilland Enterprise, The 2 & 30 „
Martin-Baker Aircraft Co., Ltd. 96 „

PROPELLER SHAFTS
de Havilland Enterprise, The 2 & 30 „

PROPELLERS
de Havilland Enterprise, The 2 & 30 „
Fairey Aviation Co., Ltd., The 34 „
Fiat S.p.A. .. .. .. 62 „
Omnipol Ltd. (Czechoslovakia) 52 „

PROTECTIVE CLOTHING
M.L. Aviation Co., Ltd. .. 83 „
Siebe, Gorman & Co., Ltd. .. 82 „

PUBLIC ADDRESS EQUIPMENT
Marconi's Wireless Telegraph Co., Ltd. .. .. .. 94 „
Redifon Ltd. .. .. .. 99 „

PUBLISHERS
Iliffe & Sons, Ltd. .. .. 3 „
Sampson Low, Marston & Co., Ltd. .. .. .. 83 & 88 „

PUMPS, AIR COMPRESSOR
Dunlop Rubber Co., Ltd. .. 98 „
Siebe, Gorman & Co., Ltd. .. 82 „

PUMPS, FUEL AND OIL
A.B.C. Motors Ltd. .. .. 88 „
Cornercroft Ltd. .. .. 6 „
Plessey Co., Ltd., The .. 93 „
Siebe, Gorman & Co., Ltd. .. 82 „

PUMPS, HYDRAULIC
A.B.C. Motors Ltd. .. .. 88 „
Automotive Products Co., Ltd. 20 „
Goodyear Tyre & Rubber Co. (Great Britain) Ltd. .. .. 49 „
H.M.L. (Engineering) Ltd. .. 35 „
Integral Ltd. .. .. .. 86 „
Plessey Co., Ltd., The .. 93 „
Siebe, Gorman & Co., Ltd. .. 82 „

PUMPS, VACUUM
Plessey Co., Ltd., The .. 93 „
Siebe, Gorman & Co., Ltd. .. 82 „

PUNCHING AND SHEARING MACHINERY
Edwards, F. J., Ltd. .. .. 9 „

QUARTZ CRYSTALS PAGE
Marconi's Wireless Telegraph Co., Ltd. .. .. .. 94 adv.

RADAR FOR NAVIGATION, WARNING, INTERCEPTION, FIRE CONTROL AND AIRFIELD SUPERVISION
Avco-Lycoming .. .. .. 26 adv.
Ferranti Ltd. .. .. .. 81 „
Marconi's Wireless Telegraph Co., Ltd. .. .. .. 94 „
Martin, The Glenn L. Co. .. 56 „

RADIATORS
Marston Excelsior Ltd. .. 85 „

RADIO AIRPORT CONTROL EQUIPMENT
Marconi's Wireless Telegraph Co., Ltd. .. .. .. 94 „

RADIO EQUIPMENT
Kollsman Instrument Corporation (U.S.A.) .. .. 102 „
Marconi's Wireless Telegraph Co., Ltd. .. .. .. 94 „
Plessey Co., Ltd., The .. 93 „
Redifon Ltd. .. .. 99 „
Standard Telephones and Cables Ltd. .. .. .. 29 „

RADIO NAVIGATION EQUIPMENT
Marconi's Wireless Telegraph Co., Ltd. .. .. .. 94 „

RADIO OVERHAUL
Fiat S.p.A. .. .. .. 62 „
Vosper Ltd. .. .. .. 42 „

RADIO SCREENING FITTINGS
Plessey Co., Ltd., The .. 93 „

RAFTS
Cory Brothers & Company Ltd. 77 „

RECORDERS, FLIGHT TEST EQUIPMENT
M.S.S. Recordings Co. Ltd. .. 84 „

RECORDERS, HIGH SPEED, MECHANICAL AND ELECTRONIC
Brown, S. G. Ltd. .. .. 85 „
M.S.S. Recordings Co. Ltd. .. 84 „

REFERENCE BOOKS
"Flight Handbook" .. .. 3 „
"Gas Turbines and Jet Propulsion for Aircraft" .. .. 3 „

REFUELLING LAUNCHES
Thompson Brothers (Bilston) Ltd. 75 „
Vosper Ltd. .. .. .. 42 „

REPAIR AND MAINTENANCE OF AIRCRAFT
de Havilland Enterprise, The 2 & 30 adv.
Dornier Reparatur-Werft G.m.b.H. .. .. .. 64 „
Fairey Aviation Co., Ltd. The 34 „
Fokker, N. V. Koninkluke Nederlandse Vliegtuigenfabriek 60 „
Hawker Siddeley Group Ltd. 14 „
Omnipol Ltd. (Czechoslovakia) 52 „

REPAIR AND OVERHAUL OF AERO ENGINES
Avco-Lycoming .. .. .. 26 „
Burnley Aircraft Products Ltd. 66 „
de Havilland Enterprise, The 2 & 30 „
Hawker Siddeley Group Ltd. .. 14 „
Omnipol Ltd. (Czechoslovakia) 52 „



HEENAN & FROUDE LTD · WORCESTER · ENGLAND

REPETITION WORK PAGE
A.B.C. Motors Ltd. .. .. 88 adv.
Cornercroft Ltd. .. .. 6 „
Plessey Co., Ltd., The .. 93 „
Western Manufacturing (Reading) Ltd. .. .. 87 „

RESCUE CRAFT
Vosper Ltd. .. .. .. 42 „

RESINS (SYNTHETIC)
Aero Research (Araldite) Ltd. 57 „

RETAINING RINGS
Geo. Salter & Co., Ltd. .. 82 „

RINGS—GAS TURBINE, FORGED
Fiat S.p.A. .. .. .. 62 adv.

ROLLER BEARINGS—SINGLE AND DOUBLE ROW, SELF ALIGNING
Fiat S.p.A. .. .. .. 62 adv.
Shafer Bearing Division of Chain Belt Company (U.S.A.) .. 100 „

RUBBER ACCESSORIES
Dunlop Rubber Co., Ltd. .. 98 „

RUBBER MOULDING, PETROL AND OIL RESISTING
Dunlop Rubber Co., Ltd. .. 98 adv.

SALVAGE EQUIPMENT
Siebe, Gorman & Co., Ltd. .. 82 „

SCIENTIFIC INSTRUMENTS
Barr & Stroud Ltd. *Inside Back Cover*
Ferranti Ltd. .. .. .. 81 adv.
Plessey Co., Ltd., The .. 93 „

SEALING RINGS
Dunlop Rubber Co., Ltd. .. 98 „

SEAPLANE, TENDERS
Vosper Ltd. .. .. .. 42 „

SEARCHLIGHTS—CRASH TENDER, FIRE FIGHTING VEHICLE
Butlers Ltd. .. .. .. 59 „

SEATS, CIVIL AND MILITARY
Fairey Aviation Co., Ltd., The 34 „
Vickers-Armstrongs Ltd. .. 70 „

SHAPING MACHINES
Edwards, F. J., Ltd. .. .. 9 „

SHEARING MACHINES
Edwards, F. J., Ltd. .. .. 9 „

SHEET, STAINLESS AND HEAT-RESISTING STEEL
Fiat S.p.A. .. .. .. 62 „
Fox, Samuel & Co., Ltd. .. 97 „

SHEET METAL WORK
Burnley Aircraft Products Ltd. 66 „
Cornercroft Ltd. .. .. 6 „
Edwards, F. J. Ltd. .. .. 9 „
Fiat S.p.A. .. .. .. 62 „
Folland Aircraft Ltd. .. .. 38 „
Marston Excelsior Ltd. .. 85 „
Western Manufacturing (Reading) Ltd. .. .. 87 „

SHOCK-ABSORBERS, OLEO-PNEUMATIC
Automotive Products Co., Ltd. 20 „
Boulton Paul Aircraft Ltd. .. 47 „
Fairey Aviation Co., Ltd., The 34 „

SHOCK-ABSORBERS, RUBBER
Dunlop Rubber Co., Ltd. .. 98 „
Sperry Gyroscope Co., Ltd., The 44 „

SIGNALLING SYSTEMS AND APPARATUS PAGE
M.L. Aviation Co., Ltd. .. 83 adv.
Standard Telephones and Cables, Ltd. .. .. 29 „

SLEEVE TARGETS
Cory Brothers & Company Ltd. 77 „

SPEED CONTROL DEVICES
Iso-Speedic Co., Ltd., The .. 5 „

SPRINGS
Fox, Samuel & Co., Ltd. .. 97 „
Geo. Salter & Co., Ltd. .. 82 „

STABILISING EQUIPMENT
Brown, S. G. Ltd. .. .. 85 „

STEEL AND STEEL ALLOYS
Fiat S.p.A. .. .. .. 62 „
Fox, Samuel & Co., Ltd. .. 97 „
Habershon, J. J. & Sons, Ltd. 61 „
Jessop, William & Sons, Ltd. 95 „
Low Moor Alloy Steelworks Ltd. .. .. 19 „

STEEL, CREEP RESISTING
Fiat S.p.A. .. .. .. 62 „
Fox, Samuel & Co., Ltd. .. 97 „
Habershon, J. J. & Sons, Ltd. 61 „
Jessop, William & Sons, Ltd. 95 „
Low Moor Alloy Steelworks Ltd. 19 „

STEEL, HEAT-RESISTING
Fiat S.p.A. .. .. .. 62 „
Fox, Samuel & Co., Ltd. .. 97 „
Habershon, J. J. & Sons, Ltd. 61 „
Jessop, William & Sons, Ltd. 95 „
Low Moor Alloy Steelworks Ltd. 19 „

STEEL, STAINLESS AND HEAT RESISTING
Low Moor Alloy Steelworks Ltd. 19 „

STEEL, STAINLESS AND RUSTLESS
Fiat S.p.A. .. .. .. 62 adv.
Fox, Samuel & Co., Ltd. .. 97 „
Habershon, J. J. & Sons, Ltd. 61 „
Jessop, William & Sons, Ltd. 95 „
Low Moor Alloy Steelworks Ltd. 19 „

STORAGE TANKS
Thompson Brothers (Bilston) Ltd. 75 „

STRIP, STAINLESS AND HEAT-RESISTING STEEL
Fiat S.p.A. .. .. .. 62 „
Fox, Samuel & Co., Ltd. .. 97 „

SUITS, CHEMICAL PROOF
Siebe, Gorman & Co., Ltd. .. 82 „

SUITS, FIREPROOF
Siebe, Gorman & Co., Ltd., .. 82 „

SUITS, FLASHPROOF
Siebe, Gorman & Co., Ltd. .. 82 „

SUITS, SURVIVAL
Cory Brothers & Company Ltd. 77 „
Siebe, Gorman & Co., Ltd. .. 82 „

SURVIVAL EQUIPMENT
Cory Brothers & Company Ltd. 77 „
Kidde, Walter Co., Ltd., The 71 „
Siebe, Gorman & Co., Ltd. .. 82 „

SWAGING MACHINES
Edwards, F. J., Ltd. .. .. 9 „

SWITCHGEAR
British Thomson-Houston Co., Ltd., The .. .. .. 41 „
Western Manufacturing (Reading) Ltd. .. .. 87 „

TANKS, PETROL, OIL AND WATER PAGE
Burnley Aircraft Products Ltd. 66 adv.
Marston Excelsior Ltd. .. .. 85 „
Thompson Brothers (Bilston) Ltd. 75 „

TARGET RELEASE AND EXCHANGER MECHANISMS
M.L. Aviation Co., Ltd. .. 83 „

TARGET TOWING WINCHES
M.L. Aviation Co., Ltd. .. 83 „

TECHNICAL PUBLICATIONS
"Aircraft Production" (Iliffe & Sons Ltd.) .. .. .. 3 „
Boulton Paul Aircraft Ltd. .. 47 „
"Flight" (Iliffe & Sons Ltd.) .. 3 „
Jessop, William & Sons, Ltd. .. 95 „
Sampson Low, Marston & Co., Ltd. .. .. .. 83 & 88 „

TENDERS FOR MARINE AIRCRAFT
Vosper Ltd. .. .. .. 42 adv.

TEST SHOP EQUIPMENT
Boulton Paul Aircraft Ltd. .. 47 „
H.M.L. (Engineering) Ltd. .. 35 „
Heenan & Froude Ltd. .. .. 24 „
Hobson, H. M. Ltd. .. .. 33 „

THERMOMETER OIL POCKETS
Amal Ltd. .. .. .. 27 „

TOOLS
A.B.C. Motors Ltd. .. .. 88 „
Garringtons Ltd. .. .. 10 „
Jessop, William & Sons, Ltd. 95 „
Plessey Co., Ltd., The .. 93 „

TOOLS, CARBIDE AND CARBIDE TIPPED
Fiat S.p.A. .. .. .. 62 „
Jessop, William & Sons, Ltd. 95 „
Plessey Co., Ltd., The .. 93 „

TOOLS, ENGINEERS', SMALL, AERO MOTOR, ETC.
Jessop, William & Sons, Ltd. 95 adv.
Low Moor Alloy Steelworks Ltd. 19 „

TOOLS, PNEUMATIC AND ELECTRIC PORTABLE
Desoutter Brothers Ltd. .. 16 adv.

TOWED TARGETS
Cory Brothers & Company Ltd. 77 „

TOWED TARGETS (MARINE TYPE)
Vosper Ltd. .. .. .. 42 adv.

TRACTORS, AIRCRAFT TOWING
Brown, David, Tractors Ltd. .. 80 „
Fiat S.p.A. .. .. .. 62 „

TRAINING DEVICES
Redifon Ltd. .. .. .. 99 „
Martin, The Glenn L. Co. .. 56 „

TRANSFORMER/RECTIFIER UNITS
British Thomson-Houston Co., Ltd., The .. .. .. 41 adv.

TRANSFORMERS, ROTARY, FOR RADIO
British Thomson-Houston Co., Ltd., The .. .. .. 41 „
English Electric Co., Ltd. The 4 & 86 „
Marconi's Wireless Telegraph Co., Ltd. .. .. .. 94 „
Newton Bros (Derby) Ltd. .. 69 „
Plessey Co., Ltd., The .. 93 „

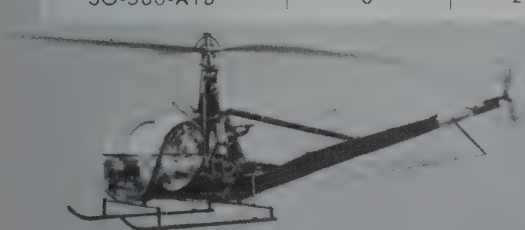


For the most complete line of engines... it's Lycoming

for every aircraft... for every job!

MODEL	#CYL	CAA#	FUEL GRADE	TAKE-OFF RATING (hp @ rpm)	NORMAL RATING (hp @ rpm)	WEIGHT (lbs.)
O-235-C1	4	223	80 87	115	108	236
O-290-D2B	4	229	80 87	140	135	264
O-320-A1A	4	274	80 87	150	150	272
O-320-B1A	4	279	91 96	160	160	278
O-340-A1A	4	277	91 96	170	170	280
O-360-A1A	4	286	91 96	180	180	285
O-435-A	6	228	80 87	190	190	392
O-540-A1A	6	295	91 96	250	250	396
VO-435-A1D	6	279	80 87	260	250	390
GO-435-C2B2	6	228	80 87	260	240	430
GO-480-B1A6	6	275	80 87	270	260	432
GO-480-G1B6	6	275	100 130	295	280	464
GO-480-G2D6	6	275	100 130	295	285	442
VO-540-A1A	6	*	80 87	310	305	435
GSO-480-B1A6	6	284	100 130	340	320	498
SO-580-A1B	8	285	100 130	400	350	578

*Pending



For further information on Lycoming's complete line of power plants, write to: Lycoming Division, Avco Manufacturing Corporation, Williamsport, Pennsylvania, U. S. A.

1908-1958 FIFTY YEARS OF POWER

Lycoming

A Division of **Avco** Manufacturing Corporation Stratford, Conn., Williamsport, Pa

TRANSPORT TANKS PAGE
Thompson Brothers (Bilston) Ltd. 75 adv.

TRAPS, FLAME
Amal Ltd. .. .. 27 ,,
Thompson Brothers (Bilston) Ltd. 75 ,,

TRUCKS—FORKLIFT AND PLATFORM
Fiat S.p.A. .. .. .. 62 adv.

TUBE—HIGH TENSILE BRASS
Fiat S.p.A. .. .. .. 62 ,,

TUBES, LIGHT METAL
Fiat S.p.A. .. .. .. 62 ,,
High Duty Alloys Ltd. .. 37 ,,

TUBES, STAINLESS STEEL
Fiat S.p.A. .. .. .. 62 ,,

TUBES, STEEL
Fiat S.p.A. .. .. .. 62 ,,
Jessop William & Sons, Ltd. 95 ,,
Low Moor Fine Steels Ltd. .. 19 ,,

TUBING, FLEXIBLE
Dunlop Rubber Co., Ltd. .. 98 ,,
Plessey Co., Ltd., The .. 93 ,,

TURRETS, GUN
Boulton Paul Aircraft Ltd. .. 47 ,,
Bristol Aeroplane Co., Ltd., The 39 & 40 ,,
Martin, The Glenn L. Co. .. 56 ,,
Sperry Gyroscope Co., Ltd., The 44 ,,

TYRES FOR AIRCRAFT
Dunlop Rubber Co., Ltd .. 98 ,,
Goodyear Tyre & Rubber Co. (Gt. Brit.) Ltd., The 49 ,,
Omnipol Ltd. (Czechoslovakia) 52 ,,

UNDERCARRIAGE EQUIPMENT PAGE
Automotive Products Co., Ltd. 20 adv.
Boulton Paul Aircraft Ltd. .. 47 ,,
Dunlop Rubber Co., Ltd .. 98 ,,
Goodyear Tyre & Rubber Co. (Great Britain) Ltd., The .. 49 ,,
Hispano Suiza .. .. .. 51 ,,

UNDERCARRIAGE GEAR, RETRACTABLE
Automotive Products Co., Ltd. 20 ,,
Hispano Suiza .. .. .. 51 ,,

VALVES
A.B.C. Motors Ltd. .. .. 88 ,,
Jessop, William & Sons, Ltd. 95 ,,
Kidde, Walter Co., Ltd., The 71 ,,
Low Moor Alloy Steelworks Ltd. 19 ,,
Plessey Co., Ltd., The .. 93 ,,
Siebe, Gorman & Co. Ltd. .. 82 ,,

VALVES, ELECTRONIC
Ferranti Ltd. .. .. .. 81 ,,

VALVES AND MINIATURE RELAYS
Plessey Co., Ltd., The .. 93 adv.
Standard Telephones & Cables Ltd. .. .. .. 29 ,,

VALVES FOR AERO-ENGINES
Jessop William, & Sons, Ltd. .. 95 ,,

VALVE GUIDES
Yorkshire Engineering Supplies Ltd. .. .. 88 ,,

VALVES, NON-RETURN, FUEL
Amal Ltd. .. .. .. 27 ,,
Plessey Co., Ltd., The .. 93 ,,

VISCOMETERS
Ferranti Ltd. .. .. .. 81 ,,

VOLTAGE AND CURRENT REGULATORS PAGE
British Thomson-Houston Co. Ltd., The .. .. .. 41 adv.
Ferranti Ltd. .. .. .. 81 ,,
Newton Bros. (Derby) Ltd. .. 69 ,,

WADING SUITS
Siebe, Gorman & Co. Ltd. .. 82 ,,

WEBBING
Mills Equipment Co., Ltd., The 88 ,,

WEIGHING MACHINES
Geo. Salter & Co., Ltd. .. 82 ,,

WHEELING AND RAISING MACHINES
Edwards, F. J., Ltd. .. .. 9 adv.

WHEELS FOR AIRCRAFT
Dunlop Rubber Co., Ltd. .. 98 ,,
Goodyear Tyre & Rubber Co. (Gt. Brit.) Ltd., The .. 49 ,,

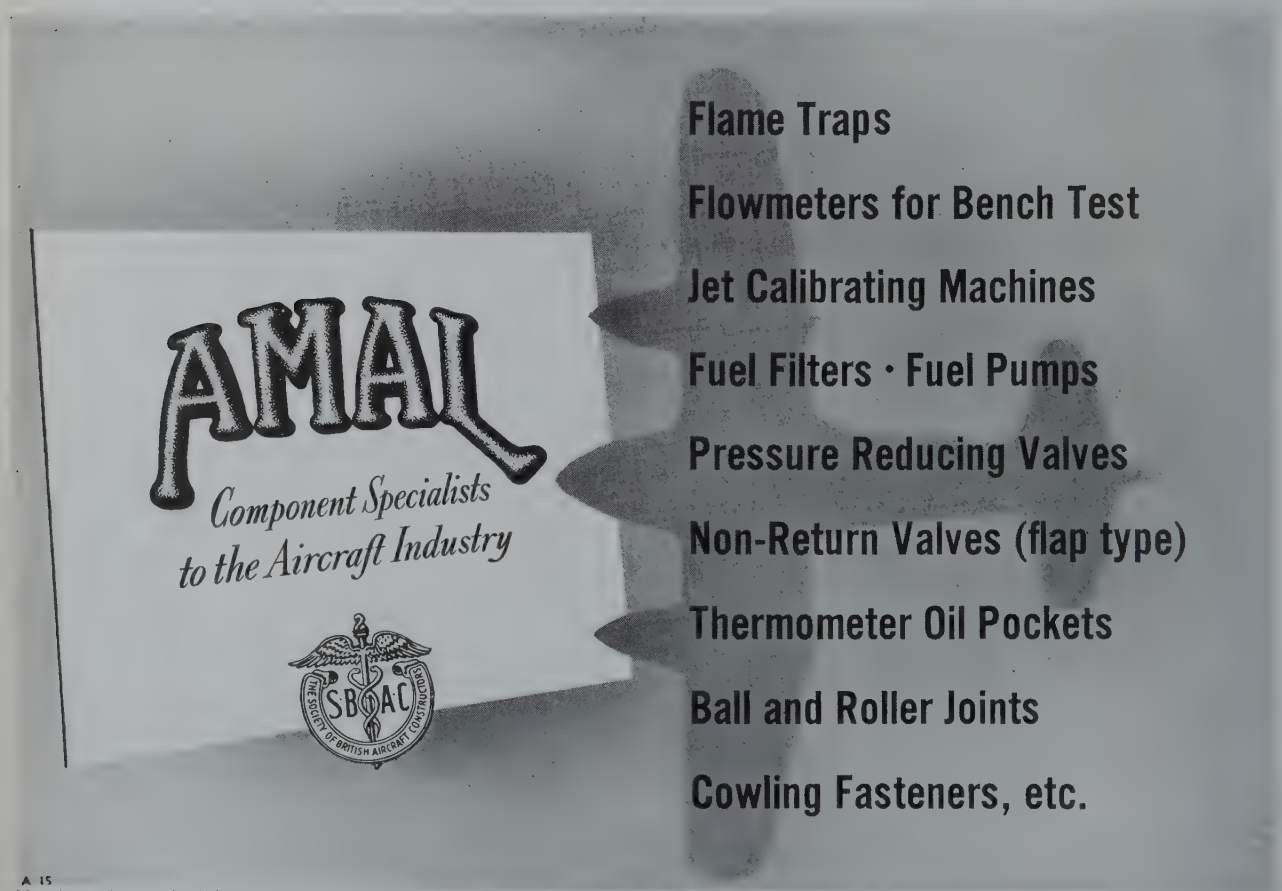
WINDSCREEN WIPERS, AIRCRAFT
Dunlop Rubber Co., Ltd. .. 98 adv.

WIND TUNNEL TESTING PLANT
English Electric Co., Ltd., The 4 & 86 ,,
Fairey Aviation Co., Ltd., The 34 ,,
Heenan & Froude Ltd. .. 24 ,,

WIRE
Fox, Samuel & Co., Ltd. .. 97 ,,

WOODWORKING MACHINERY
Edwards, F. J., Ltd. .. 9 ,,

WORKSHOP BUILDINGS
Bellman Hangars Ltd... 103 ,,

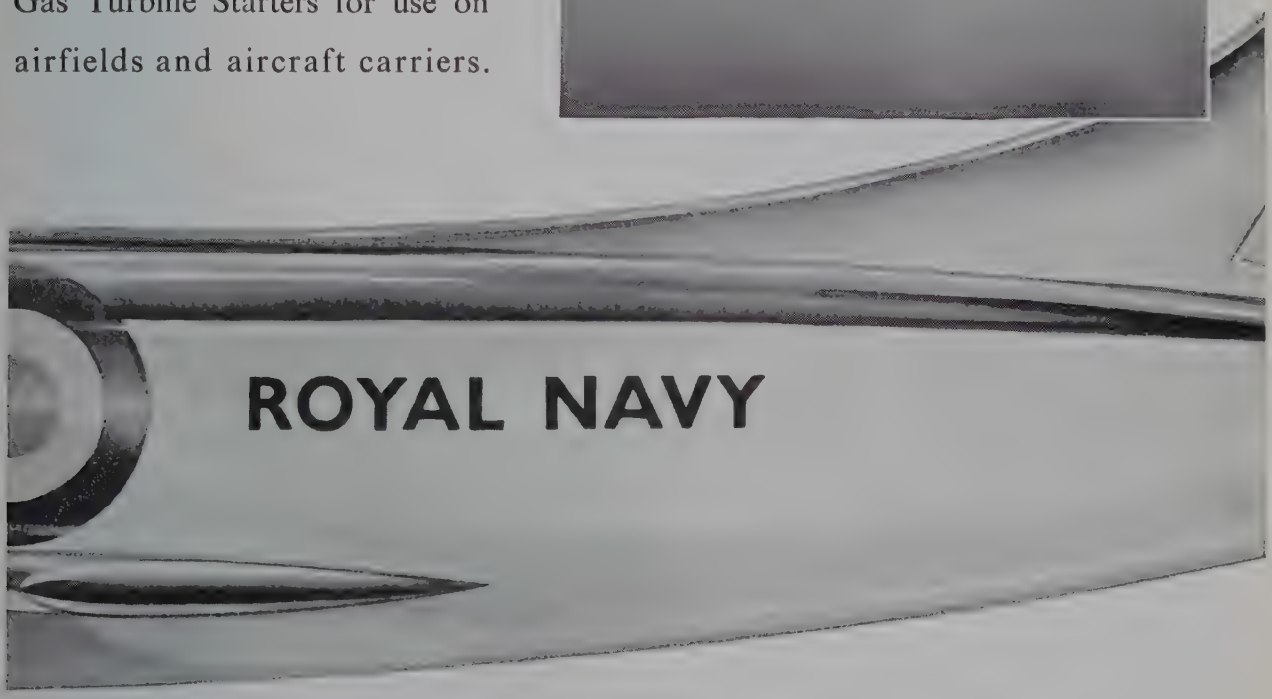


A 15
Made by AMAL LIMITED, HOLDFORD ROAD, WITTON, BIRMINGHAM, 6

Blackburn

manufacturers of Beverley Transports for the Royal Air Force, NA39 Strike Aircraft for the Royal Navy and low-pressure Gas Turbine Starters for use on airfields and aircraft carriers.

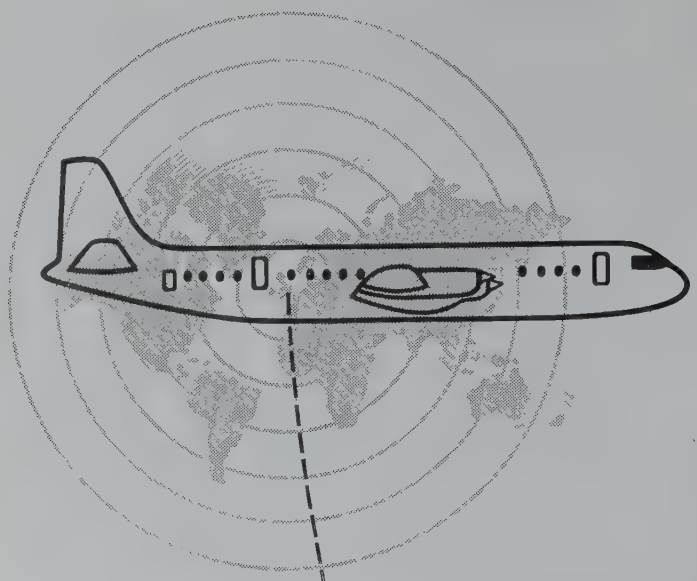






Blackburn and General Aircraft Limited, Brough, E. Yorks.

G97/g



Standard present a new concept in aviation Telecommunication Engineering

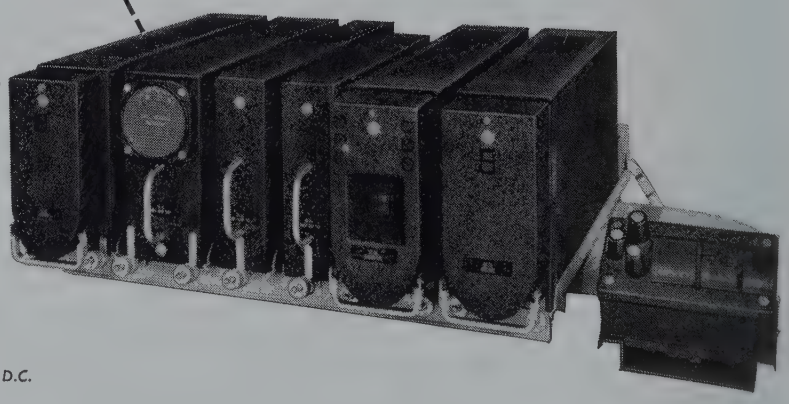
The STR.23/34/35/36 comprehensive VHF/ILS/VOR. airborne communication and navigation equipment incorporating

TRANSISTORS

The Standard S.T.R.23/34/35/36 equipment has been specified by **BRITISH EUROPEAN AIRWAYS** for their Vanguard and Comet fleets

* ST. 23 TRANSMITTER. 360 channels, 50 kc/s channel spacing, in the band 118—135.95 Mc/s. 20 watts telephony.
* SR. 23 RECEIVER 560 channels, 50 kc/s channel spacing, in the band 108—135.95 Mc/s. All spurious responses at least 90 db down.
* SR. 34 V.O.R/I.L.S LOCALISER RECEIVER. Comprises a Receiver and Instrument Drive Unit. The receiver is identical to and interchangeable with the SR23. 100 channels, 100 kc/s channel spacing, in the band 108—117.9 Mc/s (50 kc/s spacing, incorporated and available when required).
* SR. 35 GLIDE PATH RECEIVER. 20 channels in the band 329.3 to 335 Mc/s.
* SR. 36 75 Mc/s MARKER RECEIVER. (Superheterodyne).

Operates from 115 Volts, 400 c/s, single phase A.C. or 28 Volts D.C.



Approx. half the weight, half the size, and half the power consumption of equipment it replaces!

Standard Telephones and Cables Limited

Registered Office: Connaught House, 63 Aldwych, London, W.C.2.

RADIO DIVISION · OAKLEIGH ROAD · NEW SOUTHGATE · LONDON, N.11

QUALITY and DIVERSITY

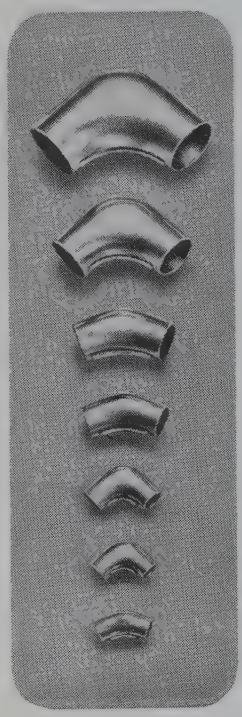
de Havilland Propellers Limited,

a major member of the world-wide Enterprise, manufacturers of a wide range of products to meet the needs of military and civil aviation—backed by more than twenty years of experience in the design, development and production of high-precision equipment.

- ★ The British Long-Range Ballistic Missile.
- ★ Variable-pitch propellers for piston and turbine engines of all sizes.
- ★ Firestreak, an advanced type of air-to-air guided weapon.
- ★ Aircraft air-conditioning systems for civil and military aircraft.
- ★ Continuously and intermittently rated alternators.
- ★ Airborne radar scanners.
- ★ Plastic components.

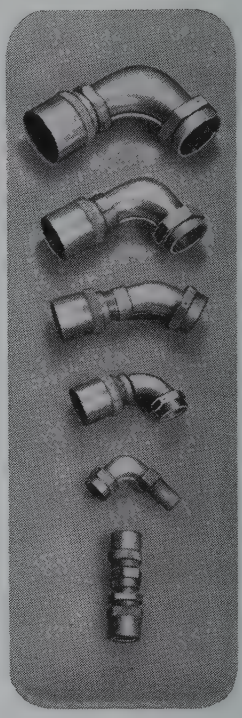
DE HAVILLAND PROPELLERS LIMITED

HEAD OFFICE: HATFIELD, HERTFORDSHIRE, ENGLAND



Flylite

Fuel Hose

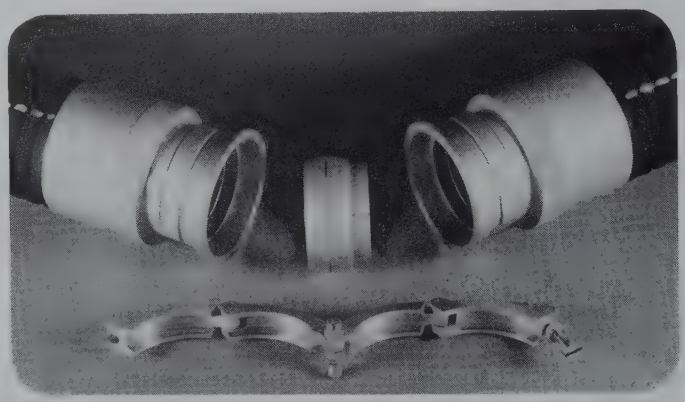


Fire Resistant
Low Pressure Fuel
Hot Oil
with
"FLYLINK" Couplings
and
Elbows

"Flyclamp" Couplings

Designed for easy assembly—an all-metal coupling eliminating jointing material, therefore is unaffected by climatic conditions. Quick assembly—designed for easy installations in inaccessible positions. Used in conjunction with *"Flylite"* Series hose, ensures the perfect installation.

ALL COUPLINGS
ARE RE-USABLE



THROUGH BORE
NO TURBULENCE

All the above Hose Assemblies approved to the Latest Specifications

THOS. BOORN & CO. LTD.
Venn Street, Clapham, London, S.W.4.

B.A.L. LTD.
Hawne Works, Halesowen, Birmingham.

AJAX PRECISION MFG. CO. LTD.
Toronto, Canada.

THE B.A.L. GROUP OF COMPANIES

SALES & EXPORT DIVISION, *Plough Hall, Clapham, London, S.W.4. England*

Telephone : Macaulay 1181, 3060, 5261

Cables : Plumbago, Clapcom, London

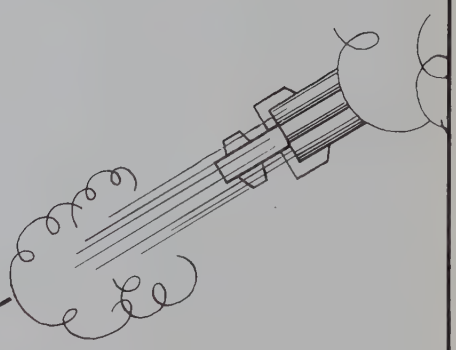
at

Shorts

ideas

take

shape



on

time

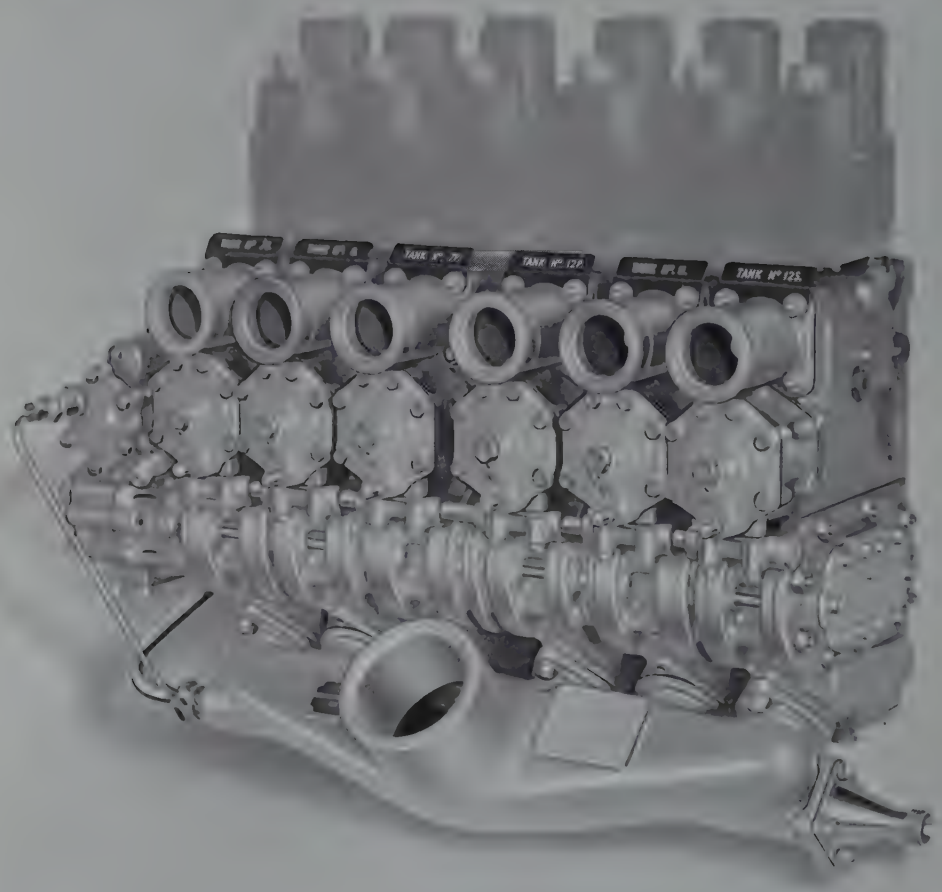
the first manufacturers of aircraft in the world

Short Brothers & Harland Ltd

Queens Island, Belfast, N. Ireland

The Hobson

Fuel Flow Proportioner



- **Maintains predetermined manifold fuel pressure under all operating conditions while accurately metering fuel flow from aircraft tanks.**
- **Maintains aircraft centre of gravity during flight refuelling.**

H. M. Hobson Limited have, over the past 40 years, been engaged in the design and manufacture of precision engineering components for aircraft, aero-engines and, more recently, atomic reactor control systems.

H. M. HOBSON LIMITED · WOLVERHAMPTON · ENGLAND

Agencies Overseas

UNITED STATES OF AMERICA
SIMMONDS AEROCESSORIES, Inc.,
Tarrytown, New York, U.S.A.

SPAIN
SENOR RAMON ESCARIO,
Nunez de Balboa 29, Madrid.

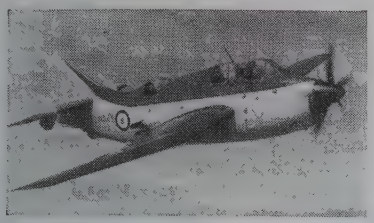
FRANCE
SOCIÉTÉ COMMERCIALE ET INDUSTRIELLE FRANCO-BRITANNIQUE,
48 Avenue Raymond Poincaré,
Paris, XVIe.

AUSTRALIA
AERONAUTICAL SUPPLY
Co. Pty. Ltd., 210 Victoria Street,
Melbourne, Victoria.

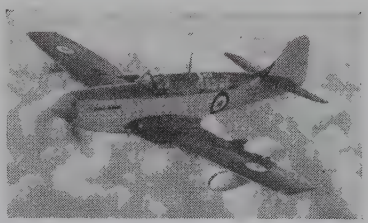
ITALY
SECONDO MONA, Somma Lombardo.

ISRAEL
CURT ISRAEL, P.O.B. 3133, Tel Aviv

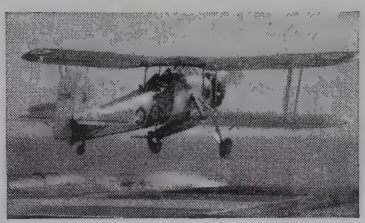
EGYPT, SYRIA, IRAQ AND LEBANON
T. G. MAPPLEBECK,
Karradet Mariam, 1/4/5 Tha'aliba Side,
Baghdad, Iraq.



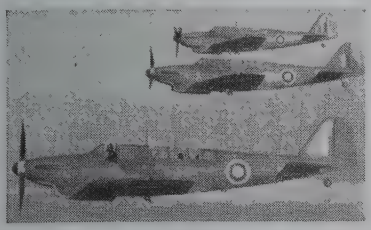
GANNET: the most advanced concept of an anti-submarine aircraft in the world: serving with the R.N. and Royal Australian Navy.



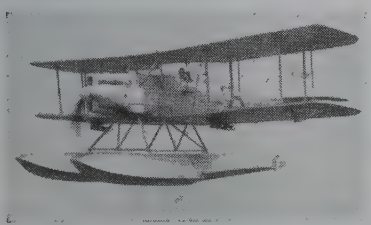
FIREFLY fleet fighter: fought the Japanese in World War 2; on naval strike operations in Korean War.



SWORDFISH: a legend in the Navy; crippled the Italian Fleet at Taranto; sealed the fate of the Bismarck.

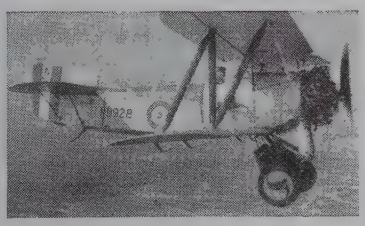


FULMAR: defended the Mediterranean convoys.



SEAFOX: operated on spotting and reconnaissance duties during the Battle of the River Plate.

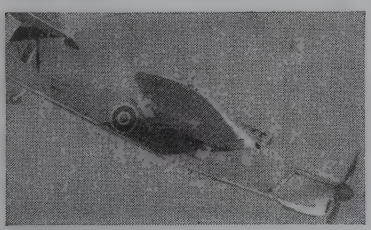
FAIREY



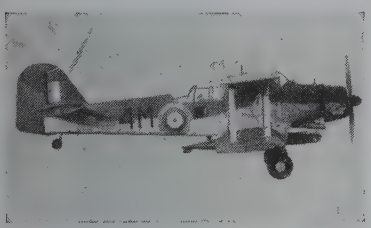
FLYCATCHER: outstandingly manoeuvrable fleet fighter of the 'twenties.



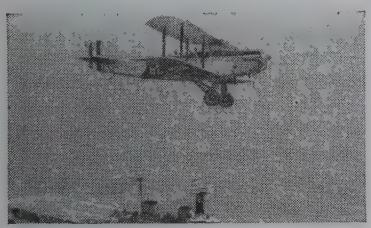
CAMPANIA: in production in 1917; carried out naval patrols during the First World War.



BARRACUDA: struck the hidden Tirpitz in Alten Fiord.



ALBACORE: the Battle of Cape Matapan.



III F Fleet reconnaissance: mainstay of the Fleet Air Arm between the wars.

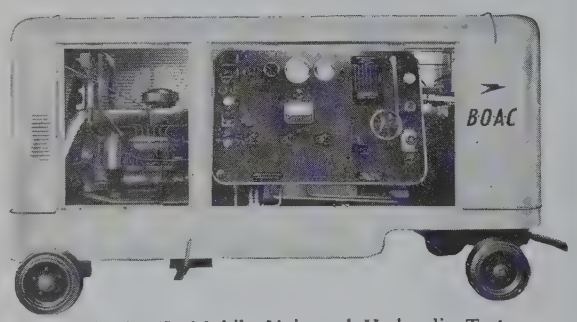
Forty-two years with the Fleet

THE FAIREY AVIATION COMPANY LIMITED · HAYES · MIDDLESEX

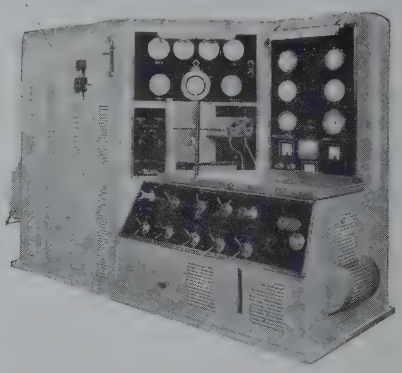
ENGLAND · AUSTRALIA · CANADA

FOR HYDRAULIC TEST EQUIPMENT

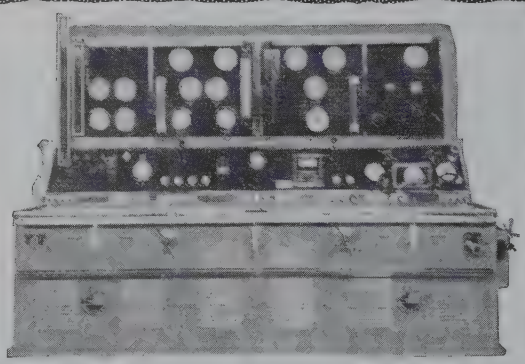
The name HML has established itself firmly in the field of Hydraulic Test Equipment. Major contracts, for servicing both civil and military aircraft, are in hand and continuous and increasing interest is being shown in HML equipment. If you have a problem in hydraulic testing, why not call us in for consultation.



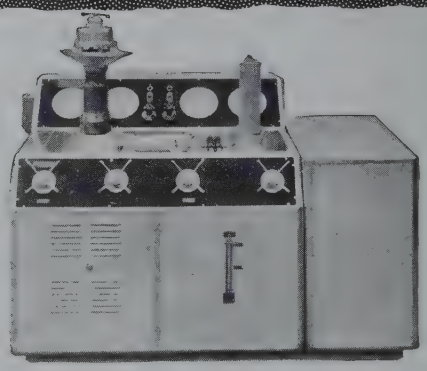
The HML Mobile Universal Hydraulic Test Rig gives operational testing on the aircraft when it is being serviced for flight.



The HML Universal Pump Test Rig designed to test hydraulic pumps with input torques up to 148 lbs. ft. from 0-2500 r.p.m. and 148-67 lbs. ft. from 2500-5500 r.p.m. in either direction i.e. 0-70 h.p. between 0-2500 r.p.m. 70 h.p. from 2500-5500 r.p.m.



The HML Universal Hydrostatic Test Rig MK XI provides bench testing for all hydraulic components and aircraft pumps.

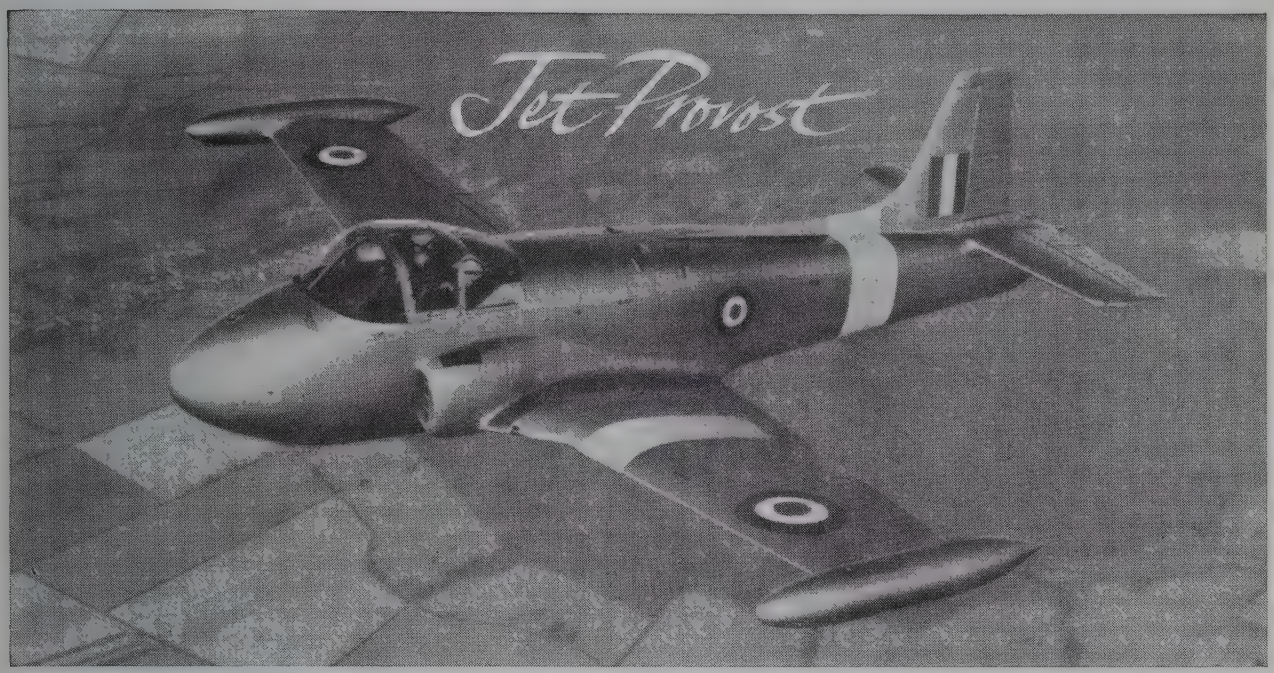


The HML Universal Propeller Component and Hub Test Bench. Designed to deal with propeller valve and hub assemblies, is universal in pressure and flow range and can be pre-set to test various propeller components.

HML EQUIPMENT INCLUDES:

Universal Hydraulic Test Rigs Mk. II and Mk. III (Diesel or Electric Powered)
Hydrostatic Rig (Single and Double acting)
Aircraft Pump and Hydraulic Motor Test Rig
Autostatic Hydraulic Power Pack
Brake Test Unit
Pulsometer Pump Test Unit
Tensioning Test Unit
High-speed Gear Boxes
High-pressure Filters
High-pressure Accumulators
Valves
Universal Hydraulic Tyre Remover
Hydraulic Propeller Test Bench

HML (ENGINEERING) LTD. AIRCRAFT DIVISION
466-490 EDGWARE ROAD, LONDON W.2. Telephone : PADington 0022



Two years service with Royal Air Force has established the jet Provost ab initio/basic trainer as the best aircraft for its purpose, and the Mk3 powered by one Armstrong Siddeley Viper Turbo-Jet is now in production for the re-equipment of Flying Training Command.

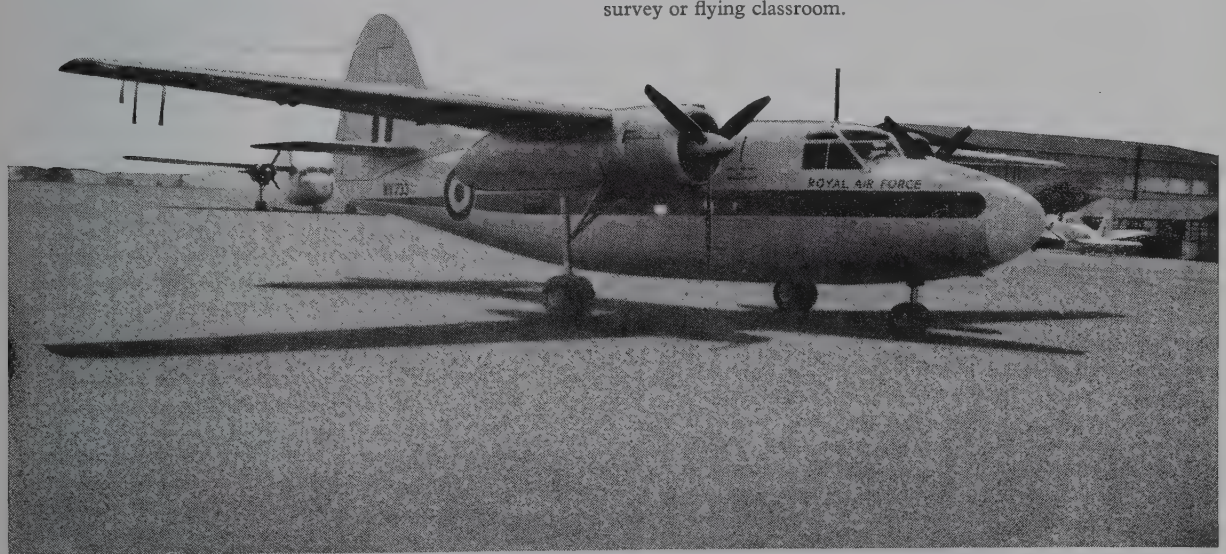
HUNTING AIRCRAFT LIMITED

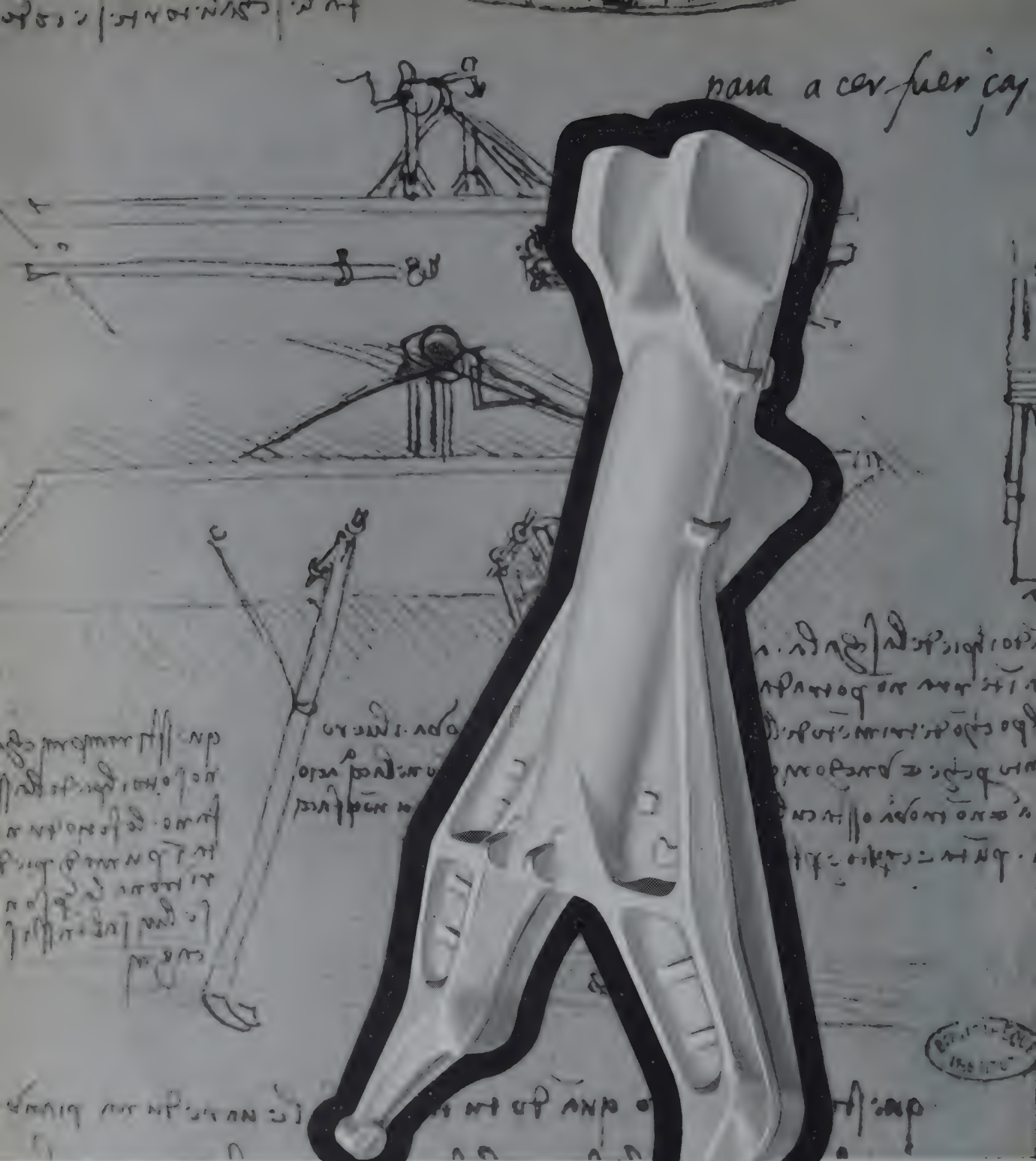
A Hunting Group Company

LUTON, BEDFORDSHIRE, ENGLAND and at 1450, O'CONNOR DRIVE, TORONTO, CANADA

Pembroke

In service with the Air Forces of seven nations, the Pembroke is a versatile general purpose military transport. Passenger seats are quickly removable for conversion to the roles of freight carrying, supply dropping, ambulance, aerial survey or flying classroom.





Background illustration from
Leonardo da Vinci's Notebooks (c.1505) "Design for a flying machine".

FORGING IN HIDUMINIUM FOR THE UNDERCARRIAGE OF THE AVRO VULCAN

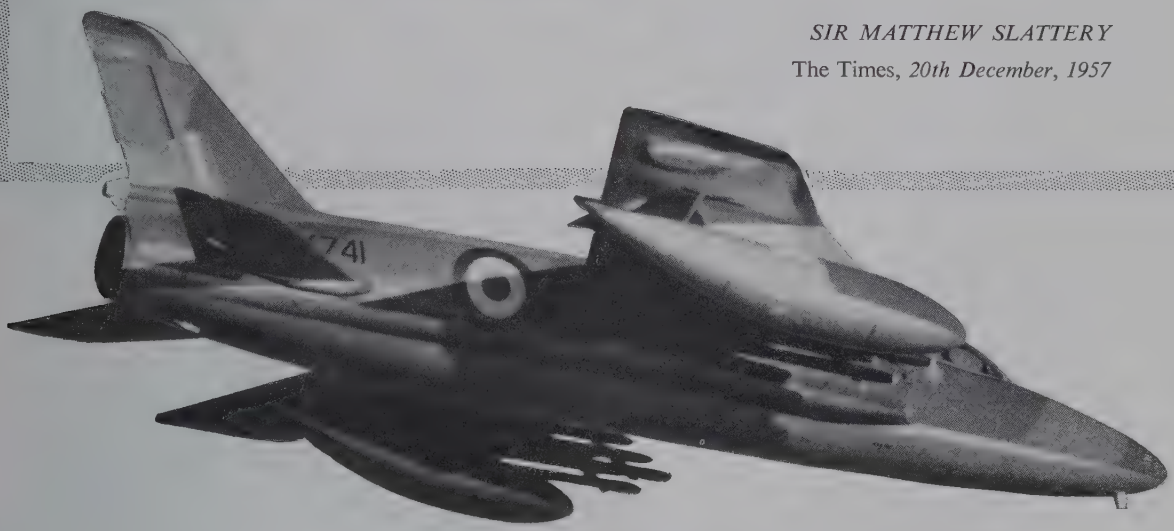
Hiduminium
makes the most of *Aluminium*

HIGH DUTY ALLOYS LTD
SLOUGH · BUCKS

THE WEAPON ON THE SPOT...

"Few, if any, can be found among knowledgeable and responsible people who really believe that missiles can replace the manned military aircraft as early as is postulated."

SIR MATTHEW SLATTERY
The Times, *20th December, 1957*



The guided missile is indeed the 'ultimate' weapon—the *last* weapon to be used or considered. That is why considered strategic thinking supports the use of more conventional weapons in the first instance; but they must be swift in execution to fulfil their object—the rapid resolution of local conflicts which could so easily spread and bring the ultimate weapon into operation. An Air Force that is flexible as well as effective is the best means of fulfilling that object.

The Folland GNAT, as the fighter component of such an Air Force, is a sound economic proposition. For it has reversed the trend to greater size, complexity and cost in more conventional fighter design. Compared with any conventional fighter, it has better manoeuvrability, a greater operating height and the most advanced armament and equipment; its simplicity makes little demand on skilled maintenance. As a strategic or tactical fighter of the first rank, the GNAT is the right aircraft, for the right job, at the right time.

FOLLAND
GNAT
LIGHT JET FIGHTER



FOLLAND AIRCRAFT LIMITED, HAMBLE, SOUTHAMPTON, ENGLAND

FLIGHT POWER



The Bristol Group of Companies is one of the world's most comprehensive aviation organisations. Bristol manufacture the Britannia, helicopters, guided weapons, ramjets, turbojets, turboprops, rocket motor tubes, drop-tanks, structural plastics and high-performance motor cars.



BRITANNIA Largest and fastest airliner in world-wide service

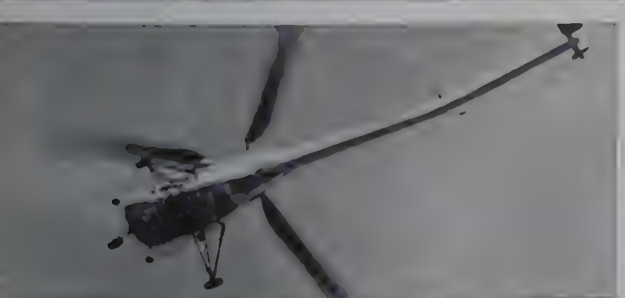


PROTEUS Most powerful turboprop in world service



OLYMPUS High-thrust turbojet — powers the Avro Vulcan

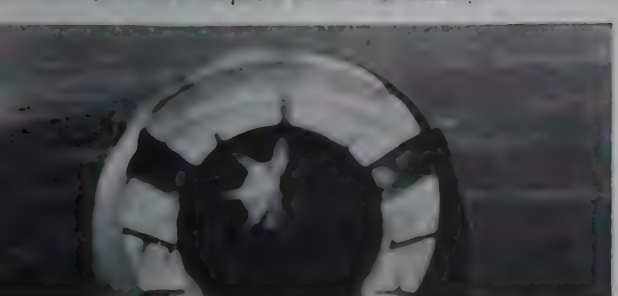




CAMORE A versatile helicopter of outstanding reliability



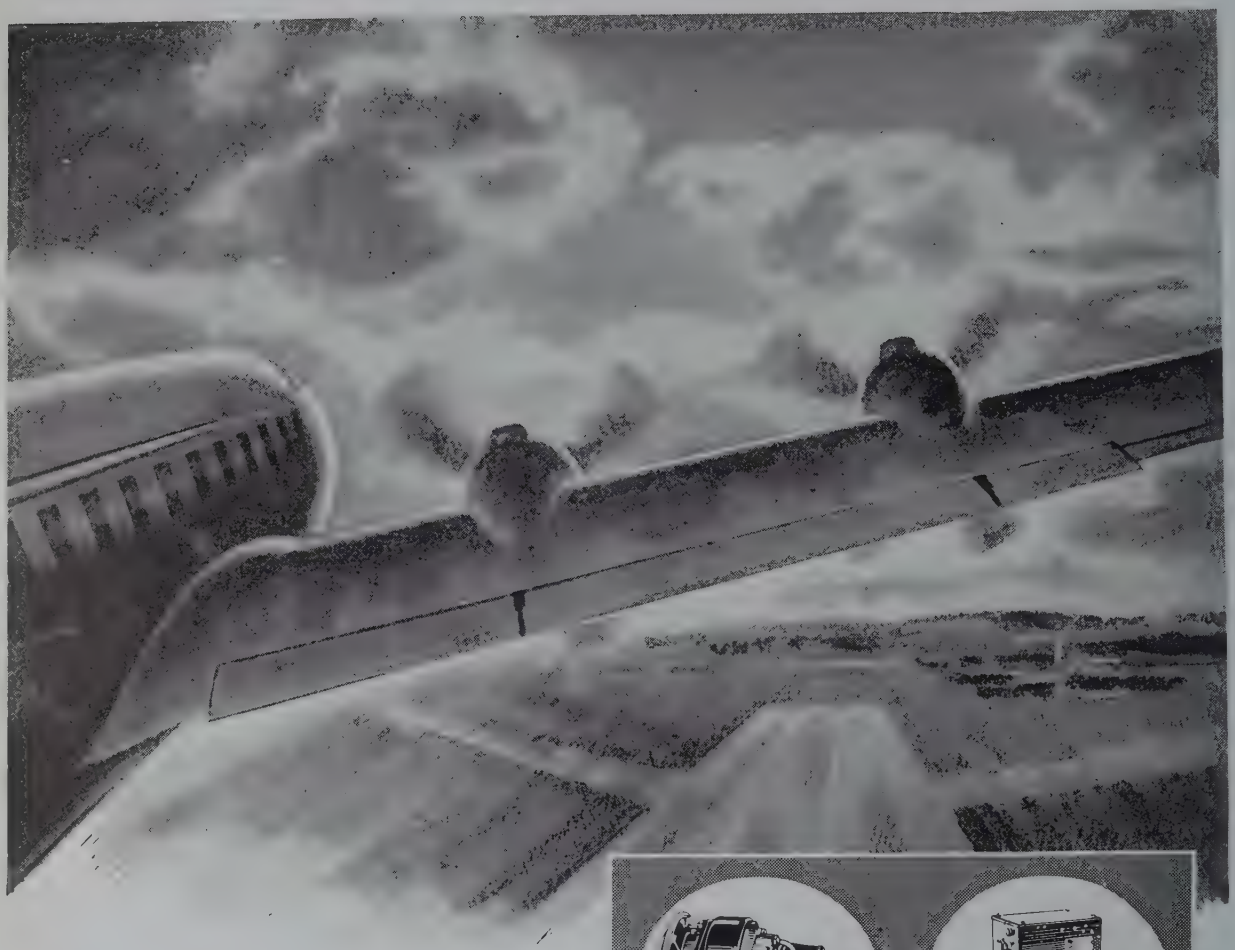
PLASTICS Bristol plastic drop tanks, standard equipment of many air forces



OR Fully proven ramjet engine powers the Bloodhound

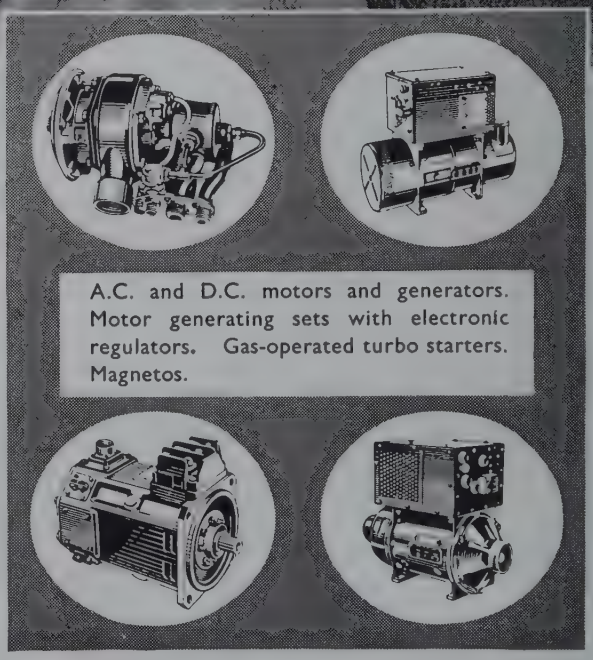
BRISTOL

GROUP OF COMPANIES



FLYING POWER . . .

The power to shock a jet into life, electric power to make cockpit and cabin bright, power to keep the compass true and control sure . . . . this is what *we* mean by flying power. From jet ignition to complete electric installations, BTH are supplying this flying power for today's leading aircraft.



A.C. and D.C. motors and generators. Motor generating sets with electronic regulators. Gas-operated turbo starters. Magnetos.

BRITISH THOMSON-HOUSTON

Electrical Equipment for aircraft

THE BRITISH THOMSON-HOUSTON COMPANY LIMITED · COVENTRY · ENGLAND

an A.E.I. Company

A5256

VOSPER LTD
PORTSMOUTH



FREEDOM OF THE AIR





No. 1 in a series of paintings by Keith Shackleton S.Av.A. presented by Cellon Limited

Snow Geese against the Sun

The Snow Goose is a native of North Eastern Arctic Canada migrating southward in the winter to the Gulf coast and southern U.S.A. It does, however, occasionally come across the Atlantic and is fairly regularly seen in small numbers in Great Britain and Ireland, generally in the company of other Arctic Geese which winter here.

CELLON AIRCRAFT FINISHES

CELLON LTD. KINGSTON-ON-THAMES, ENGLAND TEL: KINGSTON 1234 (9 lines) *Telegrams: "AJAWB, Phone, Kingston-on-Thames"*
ALSO MANUFACTURED IN AUSTRALIA, CANADA, FRANCE, HOLLAND, INDIA & NORWAY



AIDS TO FLYING IN "SPERRY WEATHER"

The aircraft is outstanding today as the only form of transport that is able to maintain cruising speed irrespective of weather conditions and this is, to a large extent, due to the flying aids made available by constant research into this problem. Sperry has been, is and will be in the forefront of research, development and production of flight instruments and control systems to ensure reliability and safety in all weathers.

SPERRY Precision Instrumentation and Control

SPERRY GYROSCOPE COMPANY LIMITED · GREAT WEST ROAD · BRENTFORD · MIDDLESEX Telephone: EALing 6771

Bryans Aeroquipment present their latest aids to

TEMPERATURE CALIBRATION AND TACHOMETER TESTING



The JETCAL

CATALOGUE No. 1632

Functionally tests the E.G.T. thermocouple circuit of a jet aircraft or pilotless missile for error, without running the engine or disconnecting any wiring.



The MOBILE TACHOMETER TESTER

CATALOGUE No. 1684

Functionally tests Tachometer and associated leads *in situ* up to an indicated speed of 24,000 R.P.M.

BRYANS AEROQUIPMENT LIMITED

WILLOW LANE, MITCHAM JUNCTION, SURREY. Telephone: MITcham 5134 (5 lines)

With the entry into service of the **CARAVELLE** on regular routes in two continents, SUD-AVIATION has perfected an organisation dealing with maintainence and after-sales problems on a world-wide basis.

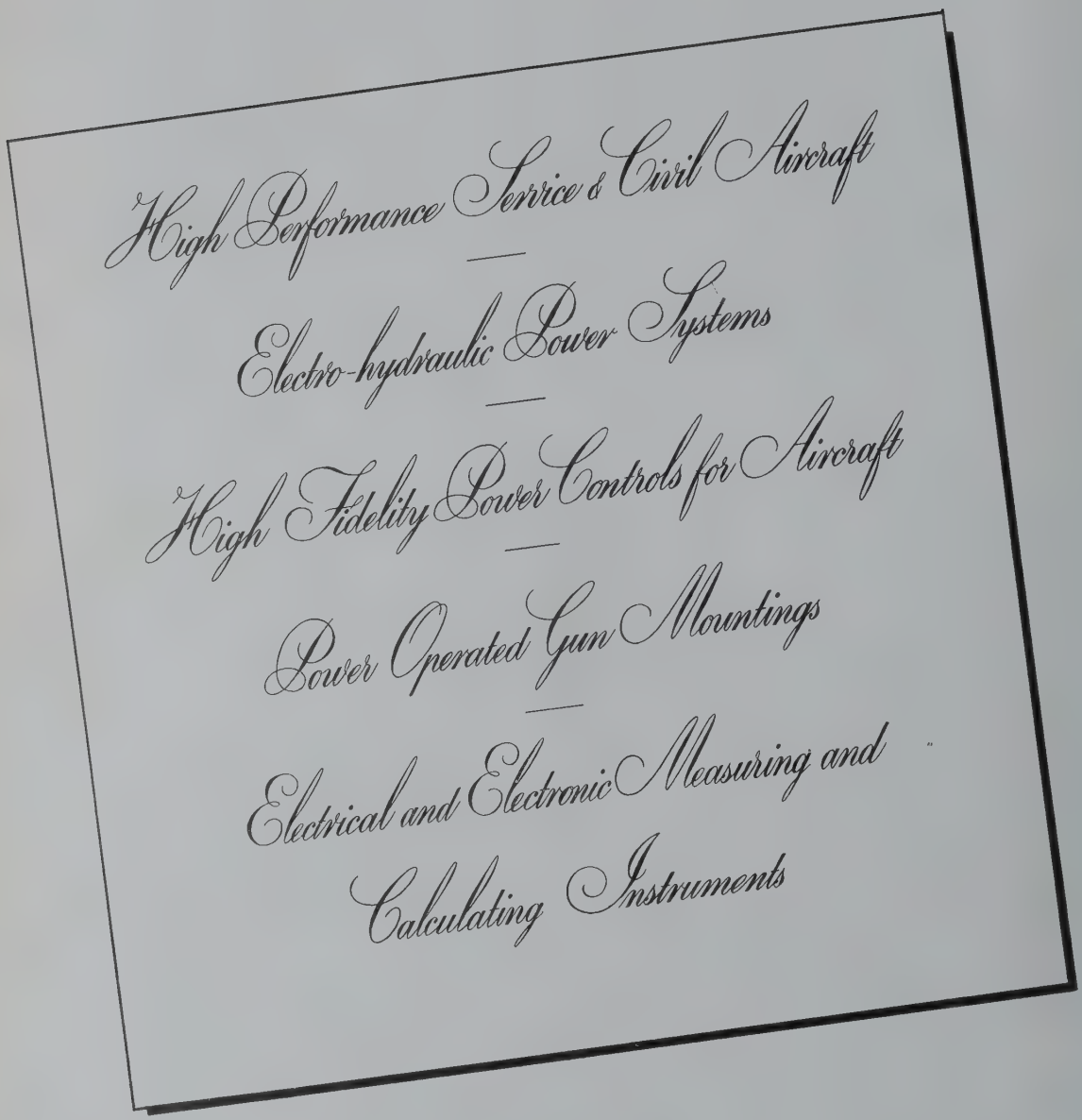
An efficient after-sales service provided for the most economic transport plane.



SOCIÉTÉ NATIONALE DE CONSTRUCTIONS AÉRONAUTIQUES

SUD AVIATION

37 - BOULEVARD DE MONTMORENCY PARIS (16e) - TEL BAG. 84-00 — SUD AVIATION CORP. 500 FIFTH AVENUE - NEW-YORK. 36. N.Y. U.S.A.



BOULTON PAUL AIRCRAFT LTD.

BPA

WOLVERHAMPTON

IN ANY ATTITUDE
THE F-105



Streaking skyward or racing along "on the deck" . . . able to intercept or retaliate against an aggressor with powerful agility . . . the new Republic F- 105 Thunderchief fighter-bomber brings to the United States Air Force a devastating weapon for defense.

REPUBLIC AVIATION

FARMINGDALE, LONG ISLAND, N. Y.

Designers and Builders of the Incomparable **THUNDER-CRAFT**



A pleasant trip, a perfect landing

and *now* a quick sure stop on

wheels, brakes, tyres, anti-skid and

control equipment by Goodyear

GOODYEAR
AVIATION
DIVISION

SERVING AVIATION THE WORLD OVER

The Goodyear Tyre & Rubber Co. (G.B.) Ltd., Wolverhampton
Airline Service Division: Room 2194, S.E. Face Building,
Central Area, London Airport. Phone: SKYport 1133.



PIPER

WORLD LEADER with the WORLD'S BEST

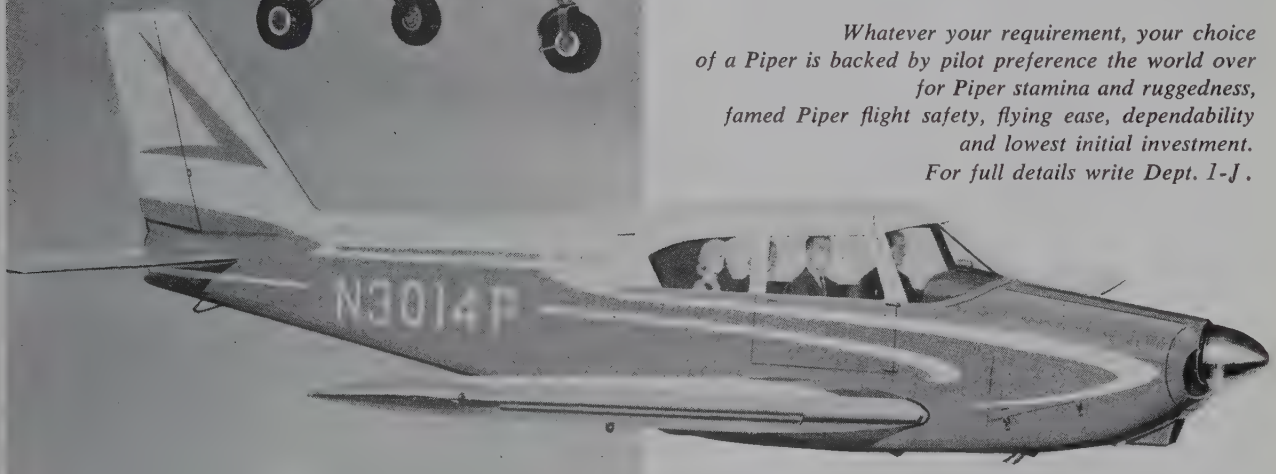
APACHE—World's largest-selling executive twin. 300 or 320 horsepower with superb Lycoming engines. Over 170 mph.

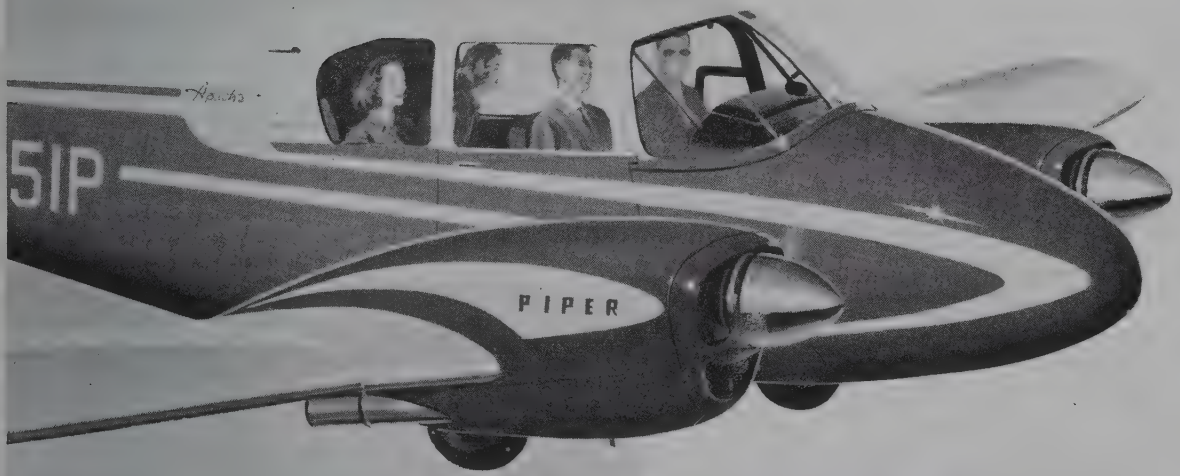
COMANCHE – Newest, most exciting business airplane, up to 180 mph cruise! 180 or 250 horsepower.

TRI-PACER – World's most popular low-cost 4-place plane. Simplest to fly. Over 130 mph.

SUPER CUB – Famed the world over for general utility flying, training, dusting, spraying.

Whatever your requirement, your choice of a Piper is backed by pilot preference the world over for Piper stamina and ruggedness, famed Piper flight safety, flying ease, dependability and lowest initial investment. For full details write Dept. 1-J.





PIPER AIRCRAFT CORPORATION
Lock Haven, Pennsylvania

MORE PEOPLE HAVE BOUGHT PIPERS THAN ANY OTHER PLANE IN THE WORLD



TURBO-JETS
LANDING GEARS
HYDRAULIC EQUIPMENT
MECHANICAL AND HYDRAULIC EQUIPMENT
FOR NUCLEAR INDUSTRY

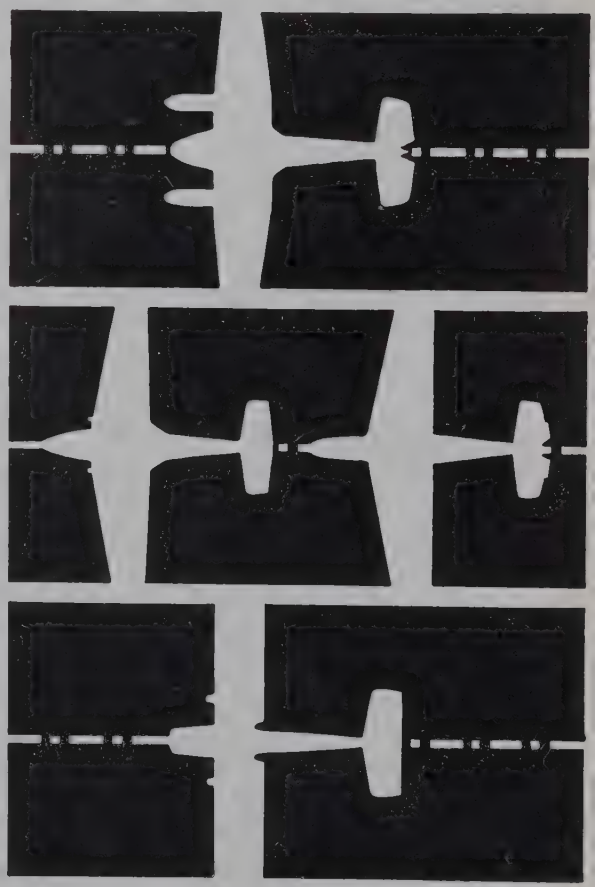
BOIS-COLOMBES — — FRANCE

WE HAVE THE PLEASURE TO PRESENT TO YOU

THREE TYPES OF WELL-PROVEN CZECHOSLOVAK AIRCRAFT . . .



SPORTS PLANES - SPECIAL PLANES - TRANSPORT PLANES



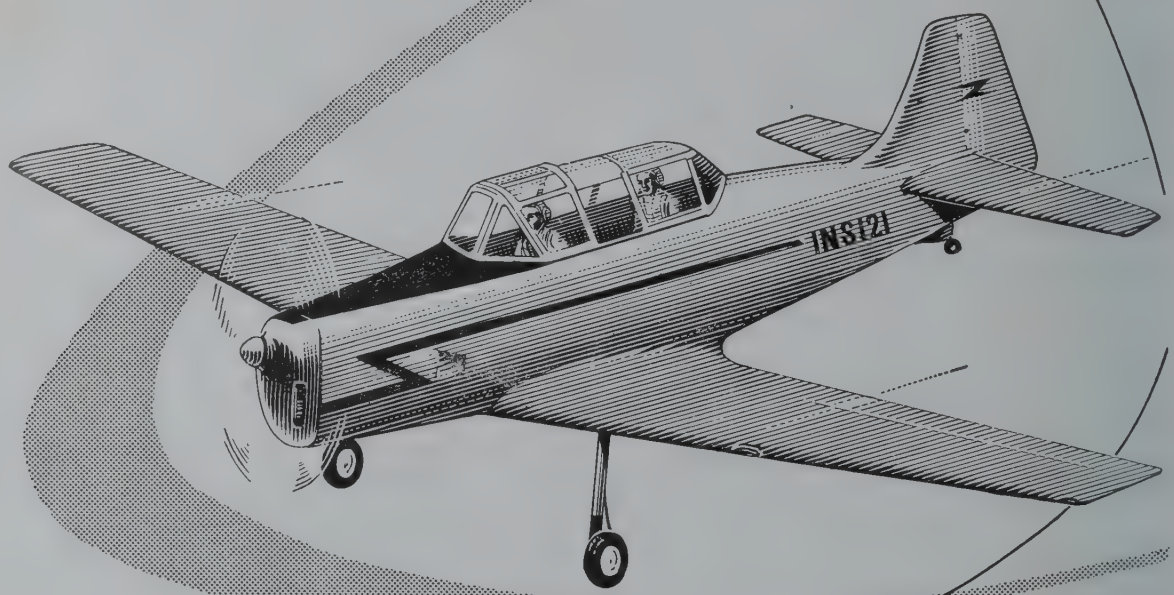
Ask for detailed offer of the type you are interested in.

We also export well-proven Czechoslovak aeroengines, instruments and training equipment.

OMNIPOL LTD., WASHINGTONOVA 11, PRAHA 3, CZECHOSLOVAKIA

HT-2 a first class trainer for a FUTURE PILOT

HT-2 an all metal aircraft of robust construction is ideal for training our pilots of to-morrow. Reports of numerous pilots testify HT-2 to be a first class aerobatic trainer of outstanding qualities both in performance and standard of workmanship.



DESIGNED AND MANUFACTURED BY

HINDUSTAN AIRCRAFT (PRIVATE) LTD.
BANGALORE, INDIA.

HAL/G/7

DAVID BROWN

STEEL CASTINGS FOR AIRCRAFT



The heat resisting and high tensile steel castings illustrated are typical of the wide variety of complex airframe and engine components supplied to all leading aircraft manufacturers.

Modern foundry techniques and rigorous inspection, including examination by X-ray and gamma ray, ensure the outstanding reliability required by present day high performance aircraft.

High tensile castings are produced to the requirements of material specifications DTD 666 and 705.

NIMONICS

CASTINGS ARE PRODUCED EITHER CENTRIFUGALLY OR STATICALLY IN NIMONICS 75 - 80 - 90

THE
DAVID BROWN
CORPORATION (SALES) LIMITED
FOUNDRIES DIVISION
PENISTONE NEAR SHEFFIELD

'take refuelling, now . . .

those BP boys are really on the ball. Their fuel's clean as a whistle and they always give us a quick turn-round. They know all about hydrant fuelling, and I hear their new fuellers will be easily the biggest ever—10,000 gallons a time. No wonder they're good to work with!'

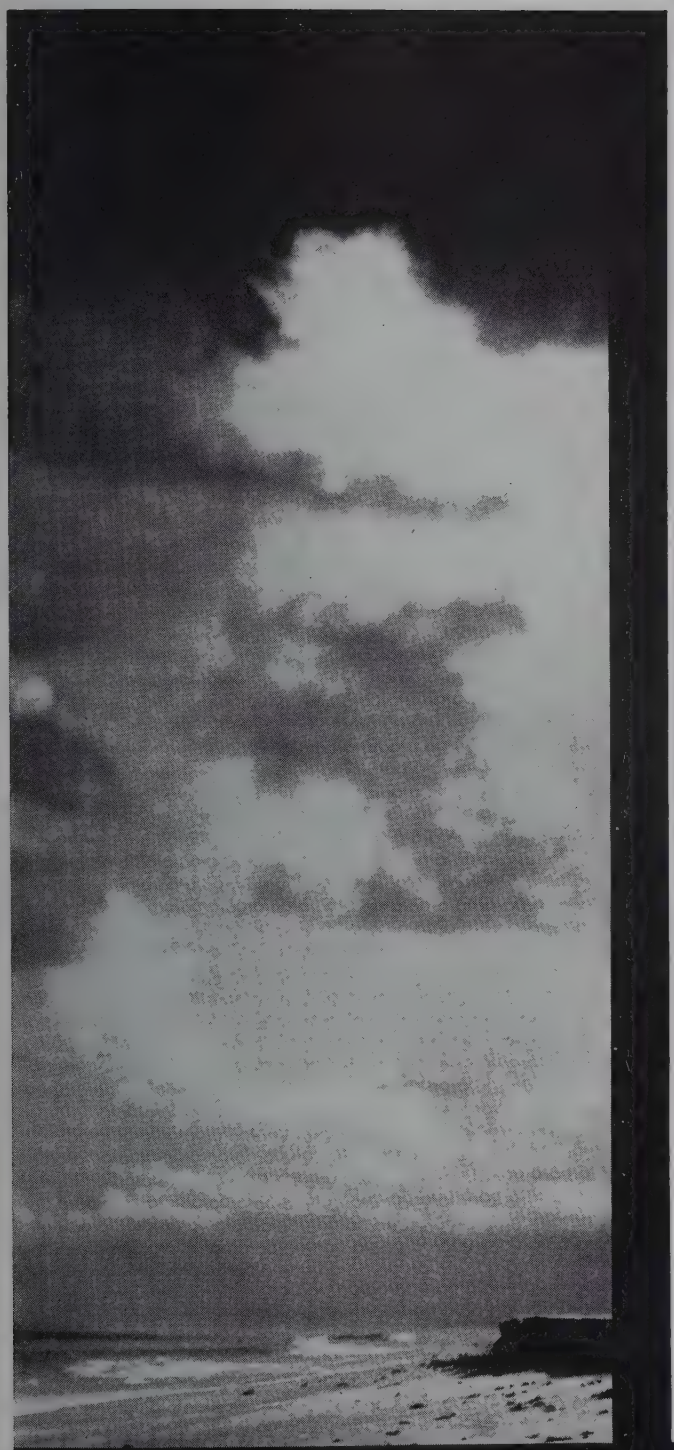


The BP Research Laboratories keep a ceaseless watch on the quality and cleanliness of BP fuels. New methods of water detection and separation . . . new advances in filtration of solid impurities . . . new fuels with higher thermal stability, to meet the relentless demands of supersonic flight—these are just a few of the BP developments which are setting new standards of safety in international air travel.

AVIATION BP SERVICE

THE INTERNATIONAL AIRCRAFT FUELLING SERVICE OF THE BRITISH PETROLEUM COMPANY





10 YEARS AGO MARTIN TOOK A CALCULATED LOOK AT THE SKY

This company's strategic position as a prime contractor to our military security, and to our scientific future in the sky, is the result of ten years of planning toward the finest available manpower and facilities in the frontier field of guided missiles.

Some 20,000 hours ago, as the missile flies, America's first operational tactical missile - the TM-61 MATADOR - was nearing the field test stage, and the Martin VIKING research rocket program was already under way.

A new age was being born. And having participated in the delivery, at that time we made a positive decision:

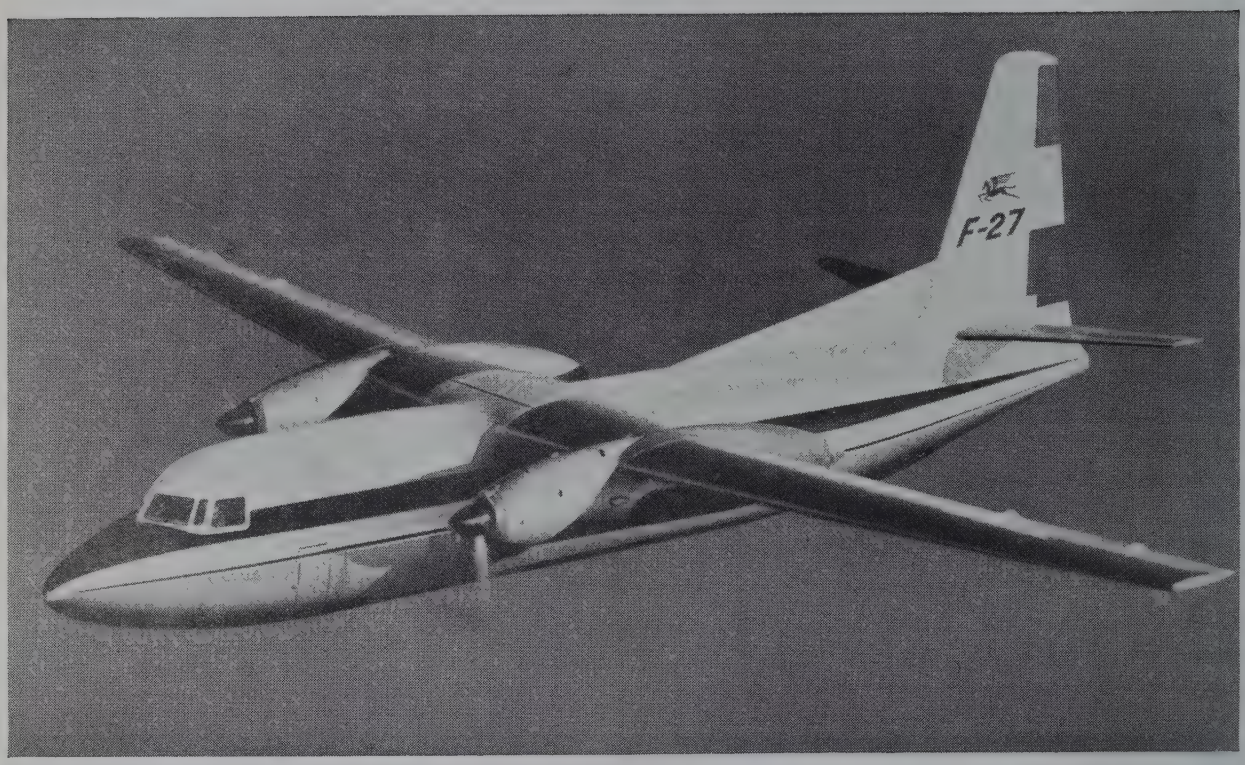
The effective development and growth of tomorrow's missiles and rockets would depend heavily, we said, upon our own ability to engineer and deliver the *total* missile system, complete with launching, guidance and operational facilities, integrally engineered for reliability in the *customer's* hands.

The decision we made was important. For today, 20,000 hours later, Martin's new missile facilities are the most modern in the industry ... the performance record of our products among the finest *in the sky,* where missiles and rockets write the true score.

MARTIN

BALTIMORE·DENVER·ORLANDO

Wherever Friendships are made



The Friendship, designed and developed by Fokker, is now being built in the United States of America by the Fairchild Corporation. This replacement for the ubiquitous DC-3—to be known in U.S.A. as the Fairchild F-27—is well known for its advanced constructional technique, employing Redux bonding on a most extensive scale. The main outer wing skin exemplifies the advantages of Redux adhesives but, in fact, Redux is used throughout the manufacture of the Friendship. This F-27 is one of more than fifty aircraft of many and varied types using Redux bonding in their construction.

Redux is used in the bonding of Aeroweb metal honeycomb cores for ultra-lightweight sandwich panels. May we send you details of Redux adhesives and Aeroweb honeycomb cores for aircraft structures?

REDUX ADHESIVES

for metal aircraft structures

Redux and Aeroweb are registered trade names

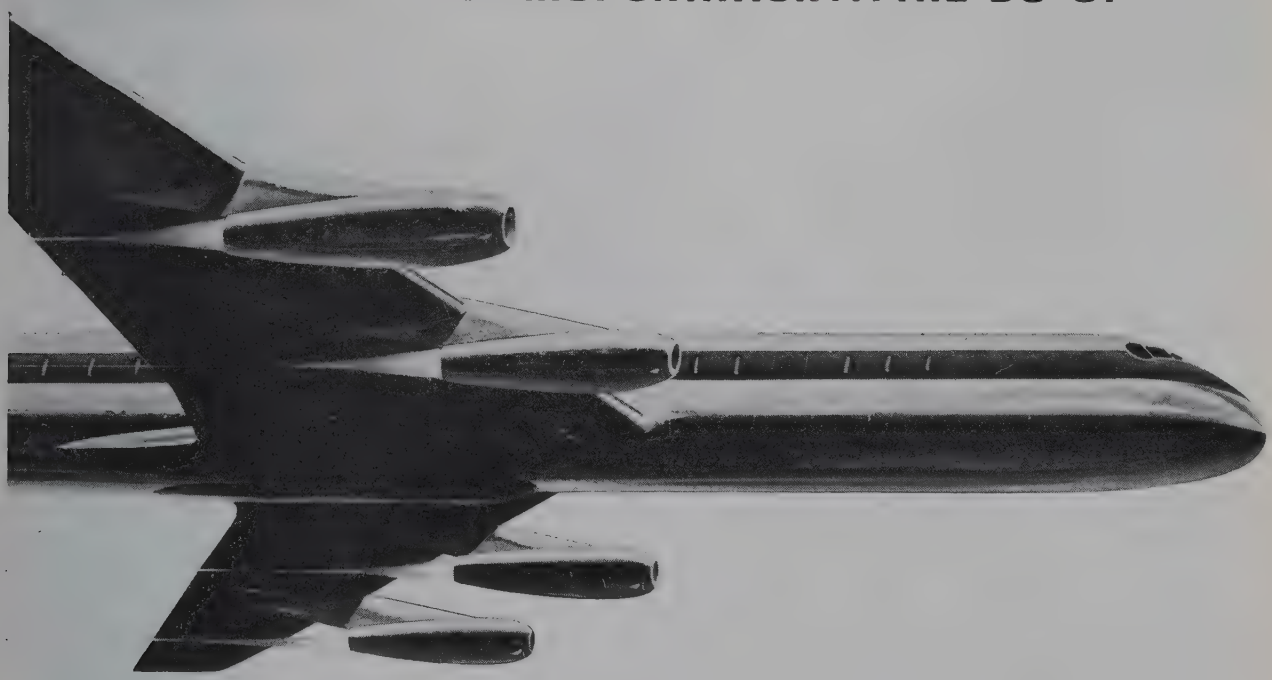
SBAC

Aero Research Limited A CIBA COMPANY *Duxford, Cambridge. Telephone: Sawston 2121*

AP 264/416

Pioneer of aviation's past... refashions its future

DOUGLAS WELDS UNMATCHED JET AND TRANSPORT EXPERIENCE INTO THE JET AIRLINER THAT WILL CREATE A NEW ERA IN TRANSPORTATION . . . THE DC-8!



● Soon . . . the speed and luxury that will change the world's travel habits. Imagine being whisked from New York to London or Paris in 6 hours . . . from Chicago to New York in only 1½ hours . . . from Tokyo to Seattle in 8½ hours . . . from Hawaii to San Francisco in 4¼ hours . . . or flying from Los Angeles to New York in 4¼ hours.

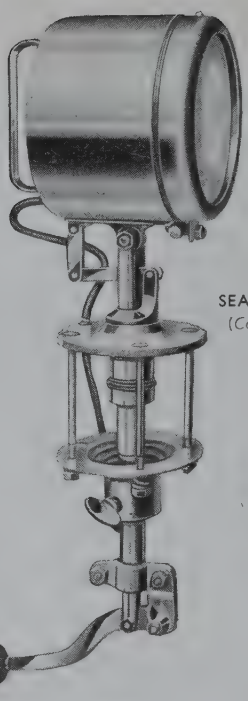
And imagine a quiet, vibrationless ride 7 miles high, far above all weather disturbances, where the sky is always blue . . . the air always smooth.

It is a traveller's dream . . . and the great new Douglas DC-8 will make it come true.

DEPEND ON DOUGLAS...FIRST IN AVIATION

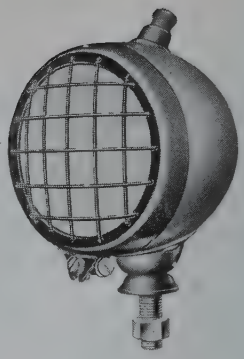


937 and 1052
AIRCRAFT LANDING
LAMPS



1121
SEARCHLIGHT
(Cab Control)

1465
DRIVING LIGHT
(Heavy-duty Crawler or Tractor)

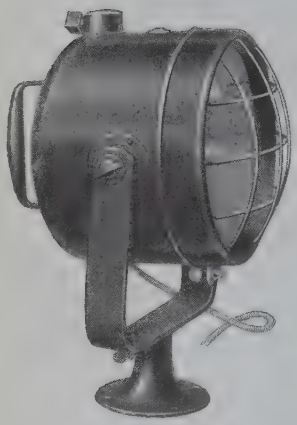


1113
TAXYING LAMP





1067/1069
U.V. COCKPIT
LAMP



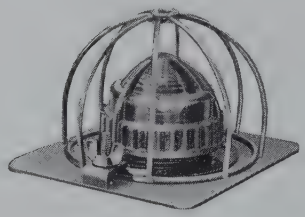
896
AMBULANCE SEARCHLIGHT



1323
ROOF WARNING LAMP
(red) for re-fuellers etc.



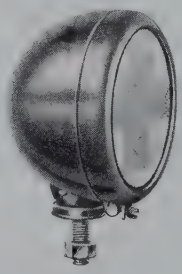
970
SWIVELLING
FLOODLIGHT



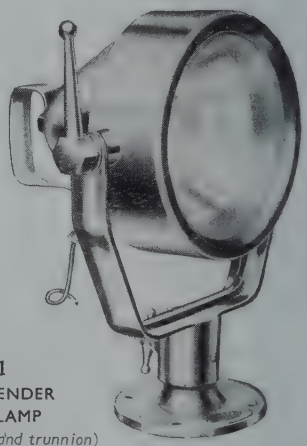
1483
PROTECTOR CAGE
(for roof warning light)



1107
AIRFIELD MARKER LIGHT



1050
AMBULANCE LAMP



1331
CRASH TENDER
FLOODLAMP
(cast alloy body and trunnion)

Butlers Limited

LAMP MANUFACTURERS

ESTABLISHED 1911

Phone: VIC. 3491-2-3-4-5-6

Grams: "VANQUISHER"

ATLANTIC WORKS, GRANGE ROAD, SMALL HEATH, BIRMINGHAM, 10

ON AIR MINISTRY, ADMIRALTY AND WAR OFFICE LISTS

Specialists in lighting equipment for all forms of transport

59 adv.



HAPPY

IS THE WORLD

THAT VALUES

Friendship

Fokker
HOLLAND



Habershon Steel has a hand in most modern aircraft

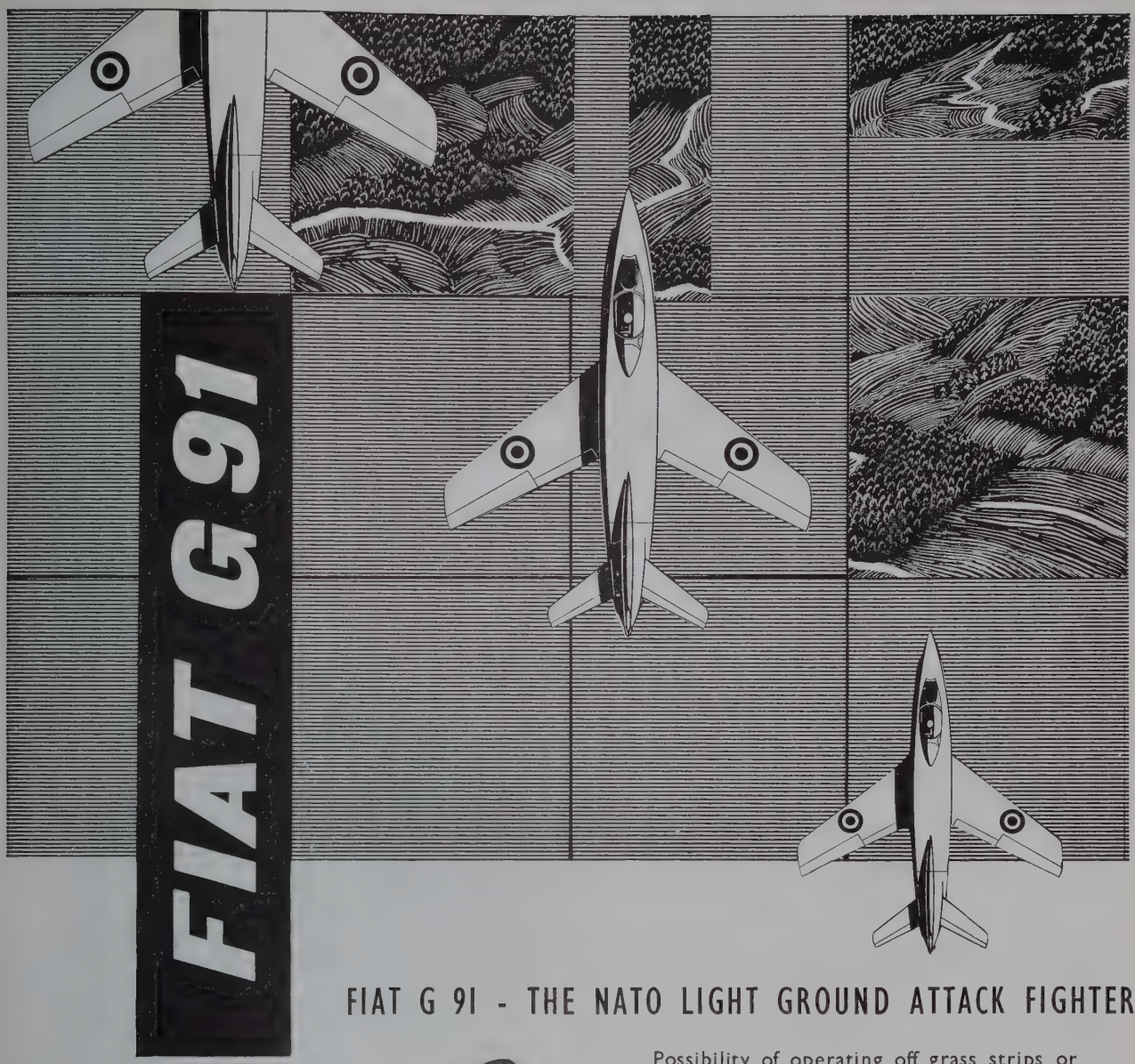
Steel strip and sheets are really essential materials in aircraft manufacture, and probably the most famous name in this connection is Habershon.
Produced to the highest standards of precision, Habershon steel is backed by more than a century's manufacturing experience.
That is why these first-class products are in constant demand throughout the aircraft industry.

Habershon STEEL STRIP & SHEETS

mean quality in quantity

J. J. Habershon & Sons Ltd., Holmes Mills, Rotherham. Tel.: 2081 (6 lines)

OA 4102



FIAT G 91 - THE NATO LIGHT GROUND ATTACK FIGHTER

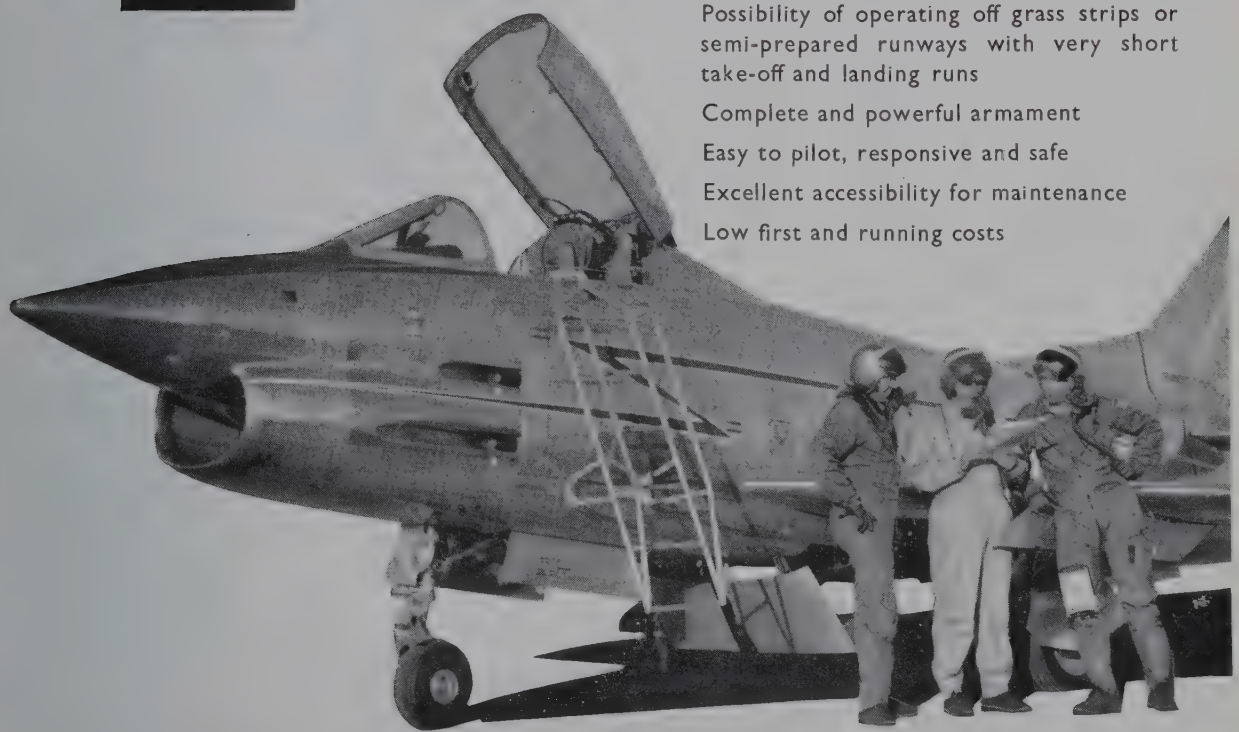
Possibility of operating off grass strips or semi-prepared runways with very short take-off and landing runs

Complete and powerful armament

Easy to pilot, responsive and safe

Excellent accessibility for maintenance

Low first and running costs



FIAT - DIVISIONE AVIAZIONE Corso Giovanni Agnelli 200 - Torino (Italy)

62 adv.

TO KEEP PACE WITH THE CONTINUING DEVELOPMENT OF AERO-ENGINES

CURRAN

HAVE PRODUCED

The

J

MARK

IC

THRUST STAND

30,000 LBS. THRUST CAPACITY

•

MAXIMUM ACCESS TO ENGINE

•

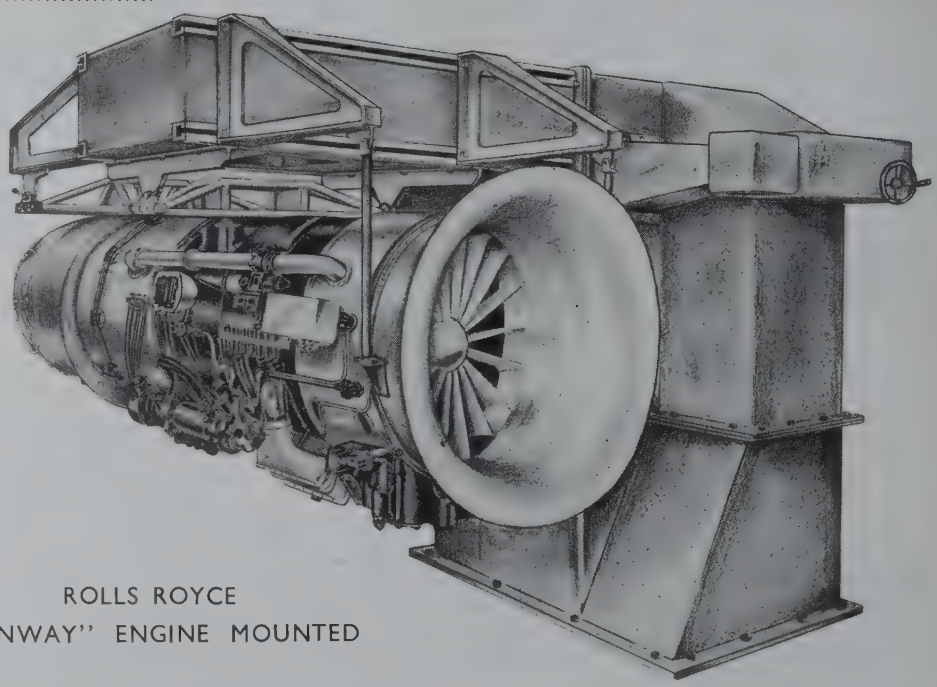
QUICK CHANGE FACILITIES

•

SIMPLE INSTALLATION

SPECIALLY DESIGNED FOR TESTING PODDED ENGINES AS FITTED TO:

BOEING 707 CARAVELLE
CONVAIR 880 D.C.8
DH.121



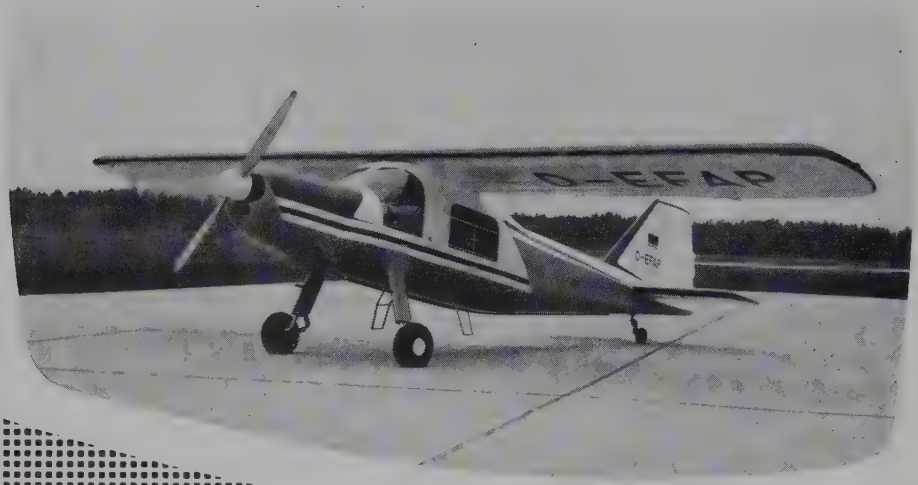
ROLLS ROYCE
"CONWAY" ENGINE MOUNTED

SERIES "J" THRUST STANDS
for Performance Testing
TURBO-JET AERO-ENGINES
Mks. I and IA also available in Mobile Version

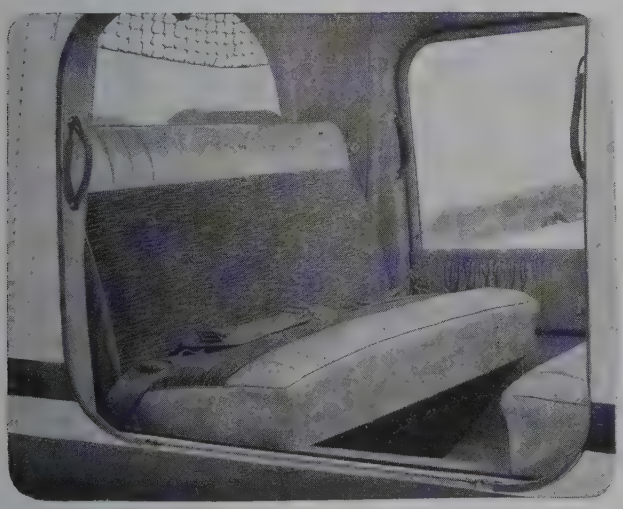
SERIES "T" TORQUE MEASURING TEST STANDS
for Performance Testing
TURBO-PROP AERO-ENGINES
as supplied for DART-TYNE-PROTEUS

JOHN CURRAN LTD., *Mechanical Engineers*, Curran Road, Cardiff — Telephone : 20641

63 adv.







DO 27

The Safe and Comfortable Short Take-off Aircraft for 6 persons.

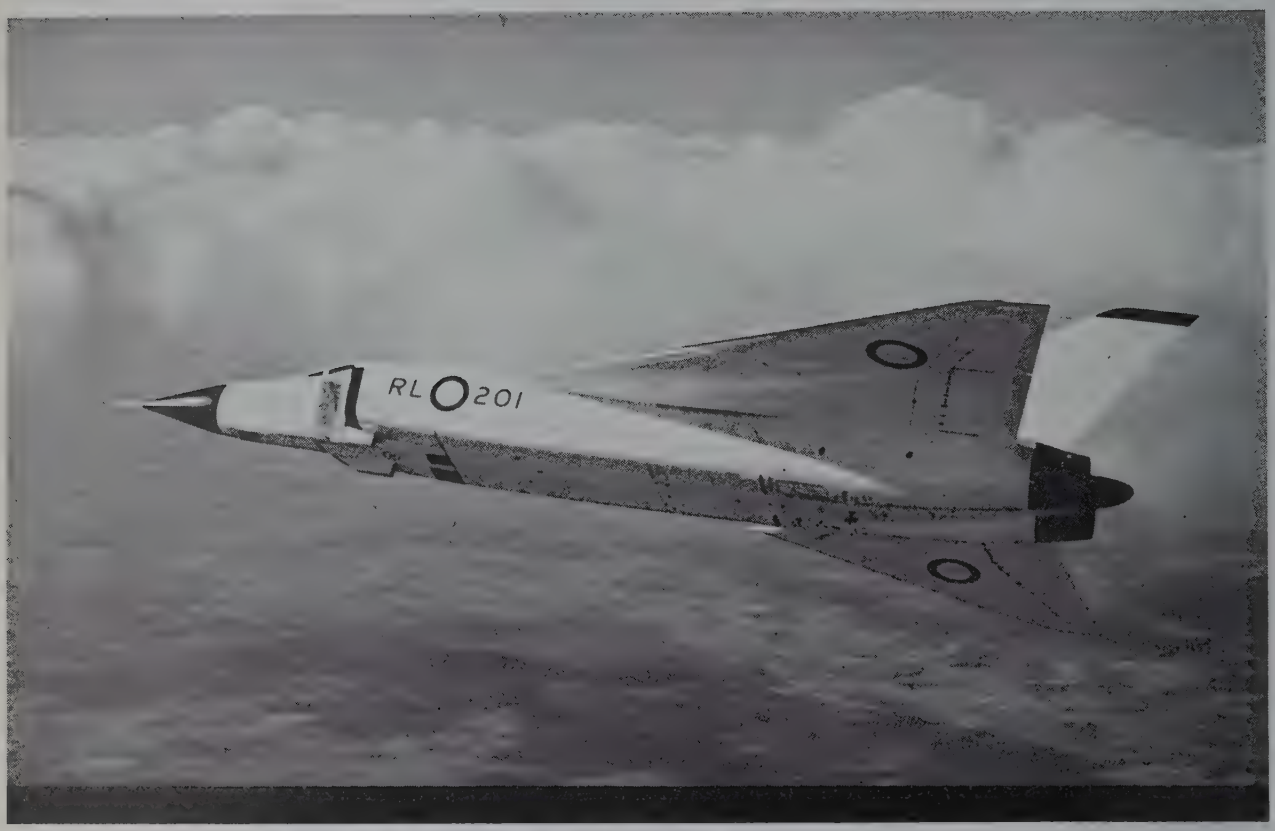
The Do 27 has proved to be a versatile aircraft for both military and civil applications. It is now also available as a passenger aircraft fulfilling the most exacting demands. Six comfortably upholstered seats for pilot and passengers, attractive cabin decoration, efficient sound proofing, a luggage compartment accessible from the outside—these are the features of the Do 27, the comfortable passenger aircraft remarkable for its superior flying qualities.

The Do 27 is a perfect aircraft for:

- Private and business flying
- Air taxi services
- Feeder services
- Ambulance and rescue services (with two stretchers)
- Agricultural and forestry services
- Aerial photography
- Survey duties
- Aerial advertising
- Towing of sail planes

DORNIER-WERKE GMBH FRIEDRICHSHAFEN—MUNICH, GERMANY

SALES: MUNICH-NEUAUBING—TELEPHONE MUNICH 8 08 35—TELEX 05-23543



▲ The Avro Arrow is shown in flight during test manoeuvres over Ontario.

The Arrow weapon system is a bomber-destroyer having supersonic mission capabilities. ▼



The Avro Arrow is as big as a World War II bomber yet took off on its first flight in only 3,000 feet of the 11,000 foot runway at Malton. ▼



AN ARROW IN THE SKY

Since its first flight on March 25th, the Avro Arrow has been meeting the vigorous demands of its extensive flight test program. Proceeding according to plan, the Arrow flew faster than sound on its third flight, and more than 1,000 miles per hour on its seventh flight.

AVRO AIRCRAFT

AVRO AIRCRAFT LIMITED

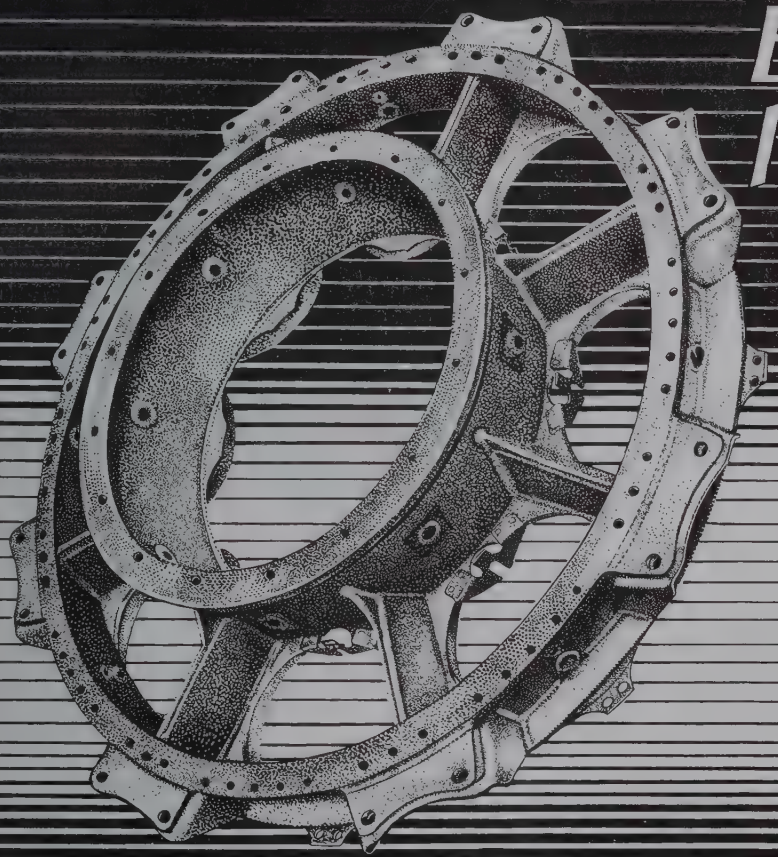
MALTON • CANADA

MEMBER: A. V. ROE CANADA LIMITED & THE HAWKER SIDDELEY GROUP

WELDED

fabrications in Heat-resisting Steel for the.....

AIRCRAFT GAS TURBINE ENGINE INDUSTRY



ENTRY CASING FABRICATED IN AUSTENITIC CHROME NICKEL STEEL, WELDED BY THE METALLIC ARC PROCESS, SUBJECTED TO STRINGENT PRESSURE AND ARDROX 900 CRACK DETECTION TESTS. *Illustration by permission of Bristol Aero-Engines Ltd.*

FIRST CLASS DEVELOPMENT, PRODUCTION AND REPAIR SERVICE FACILITIES OFFERED TO MANUFACTURERS, *A.I.D and A.R.B approved*

BURNLEY AIRCRAFT PRODUCTS LIMITED

FULLEDGE WORKS - BURNLEY - LANCASHIRE - ENGLAND

Telephone: 3121/2 and 3203 Burnley (3 lines) *Telegrams:* "AIRCRAFT" Burnley

REPAIR DIVISION: BRITANNIA WORKS · QUEENSGATE · BURNLEY · *Telephone:* 4102

INDUSTRIAL FABRICATIONS DIVISION: GROSVENOR STREET, STONEYHOLME, BURNLEY. *Telephone:* 3184

Associated with RENFREW AIRCRAFT & ENGINEERING CO. LTD., RENFREW, ONTARIO, CANADA

THE
BRITISH AVIATION
INSURANCE COMPANY LIMITED

The oldest and largest office specialising in Civil Aviation

at Your Service

HEAD OFFICE:

3-4 LIME STREET · · LONDON, E.C.3

TELEPHONE: MANSION HOUSE 0444 (6 lines) TELEGRAMS: AVIACOY, LIME, LONDON

BRANCH OFFICES

EDMONTON
317 Empire Building,
Telephone : 4-2247

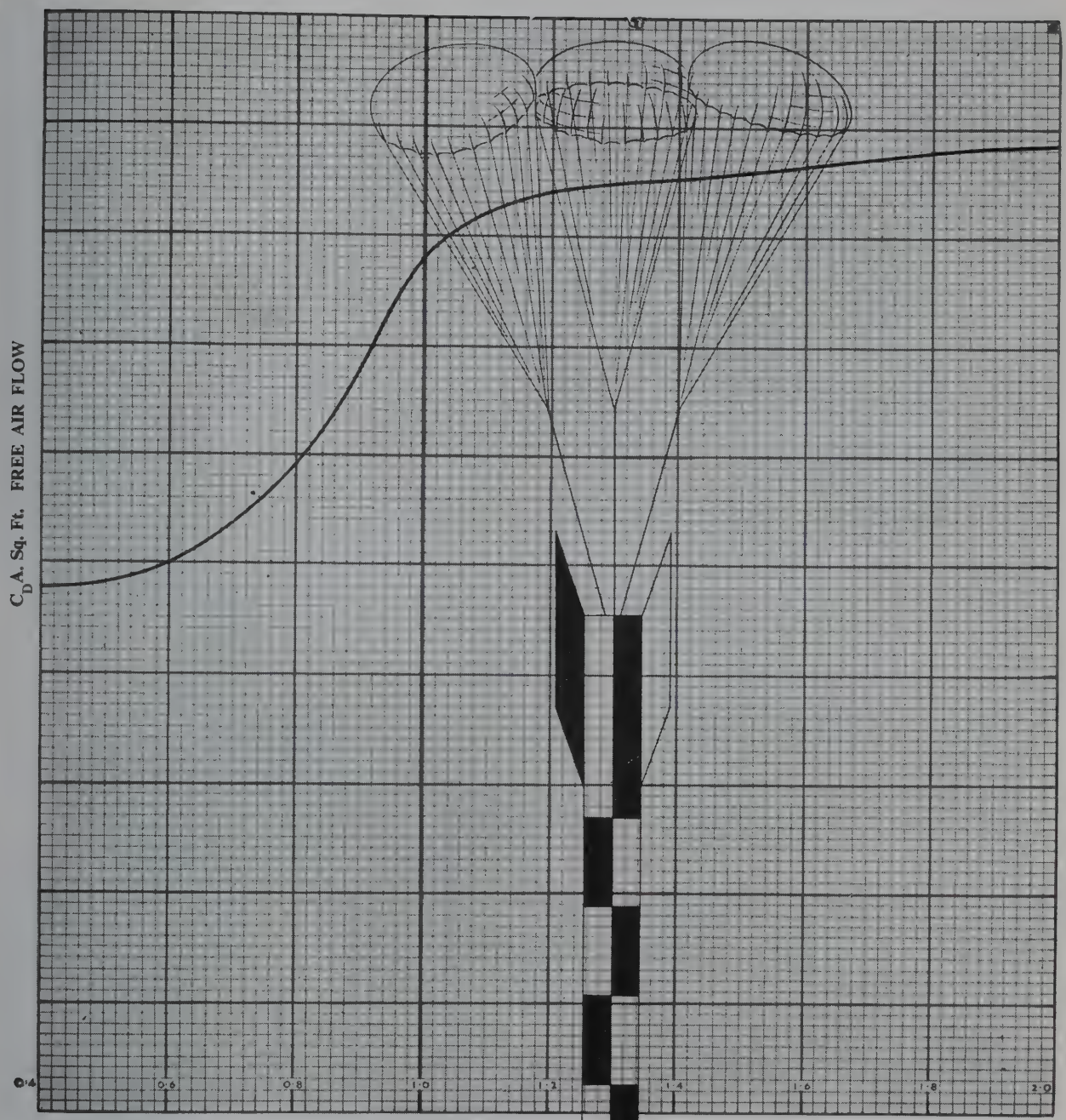
MONTREAL
276 St. James Street West,
Telephone : Avenue 8-6135

TORONTO
44, Eglinton Avenue West,
Telephone : Hudson 5-4461

JOHANNESBURG
London House, Loveday Street,
Telephone : 33-3048

CALCUTTA
2 Hare Street,
Telephone : 23-3274

BRUSSELS
99 rue de la Loi,
Telephone : 12.00.05



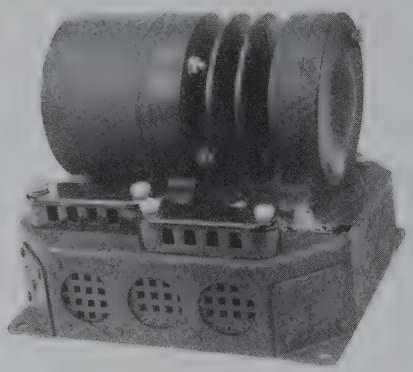
Variation of Drag Area with Mach No.

Performance curve for G.Q. Supersonic Parachute.

Leaders in Parachute development — G.Q. are designers of supersonic recovery parachutes, the performance of which has been shown in practice to relate closely to the theoretical design.

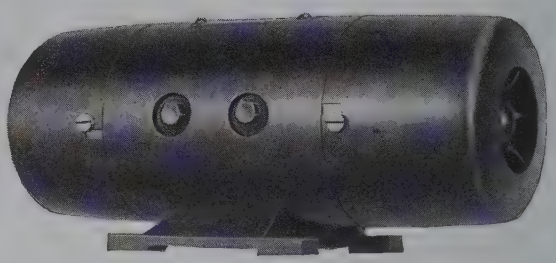
G.Q.

G.Q. PARACHUTE CO. LTD · STADIUM WORKS · WOKING · SURREY · ENGLAND



AUTOMATIC
VOLTAGE REGULATOR
TYPE 108
For the control of Invertor
Type 111. Weight 6 lbs.

NEWTON-DERBY AIRCRAFT ELECTRICAL EQUIPMENT



ROTARY TRANSFORMER FRAME D.2.2.
Up to 100 watts output. Weight 5⅞ lbs.

Many other sizes available

WE SPECIALISE in the design and manufacture of Lightweight Electrical Equipment for Aircraft.

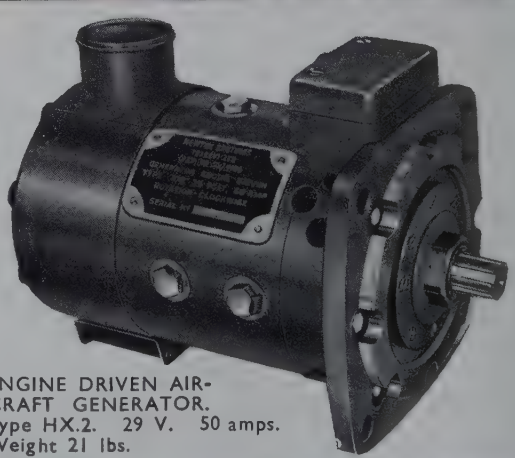
Our products include:-

NEWTON-DERBY PATENT AUTOMATIC CARBON PILE VOLTAGE AND CURRENT REGULATORS for use with aircraft generators and electrical circuits where controlled voltage or current is required.

ROTARY TRANSFORMERS AND CONVERTERS. A.C. AND D.C. ENGINE AND WIND DRIVEN LIGHTWEIGHT AIRCRAFT GENERATORS FOR Radar, Wireless, Battery charging, etc.

FRACTIONAL H.P. LIGHTWEIGHT AIRCRAFT MOTORS.

HIGH FREQUENCY ALTERNATORS

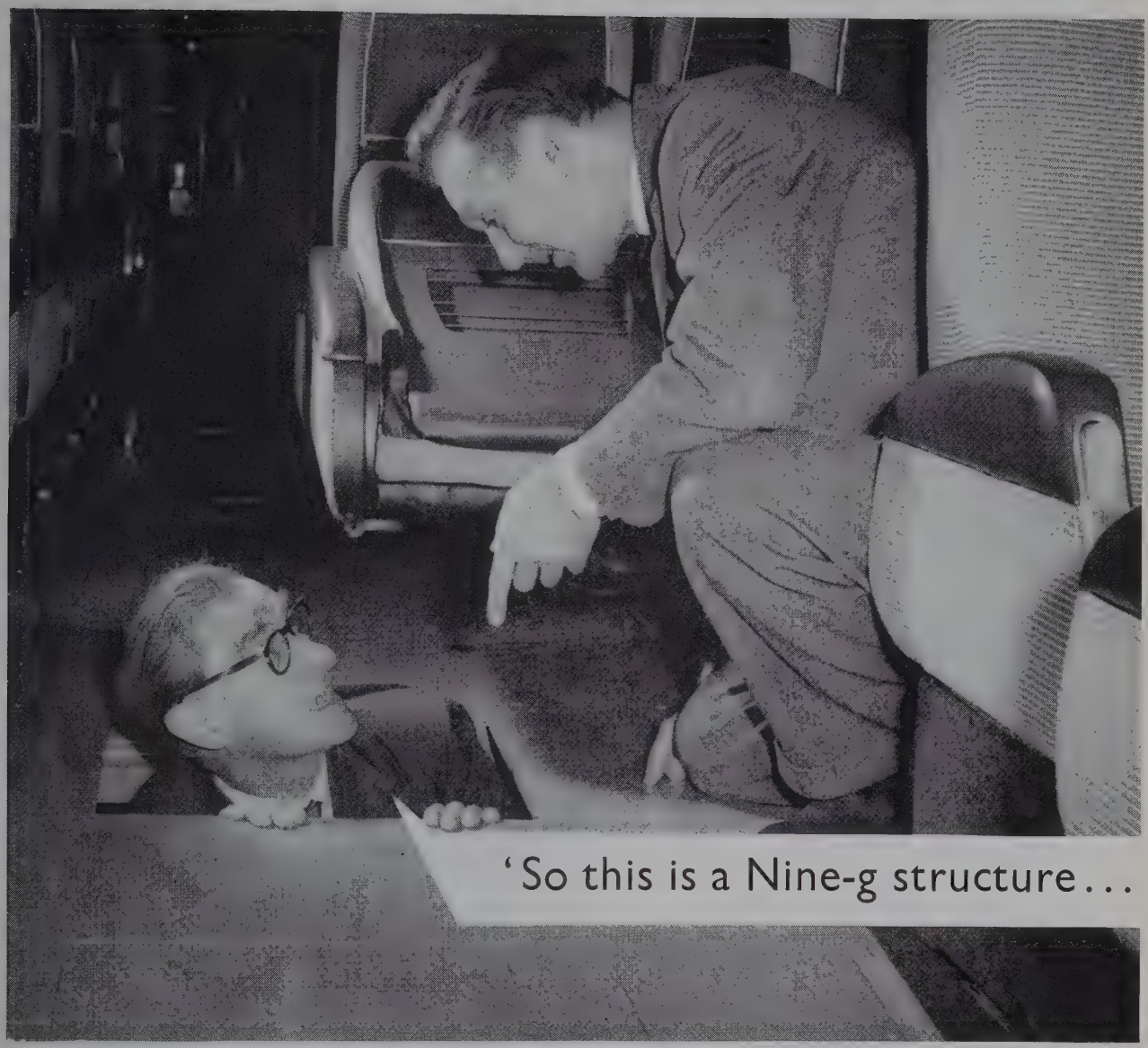


ENGINE DRIVEN AIRCRAFT GENERATOR.
Type HX.2. 29 V. 50 amps.
Weight 21 lbs.

Under A.I.D. and A.R B. approved inspection and design schemes.

NEWTON BROTHERS (DERBY) LTD.

HEAD OFFICE & WORKS: ALFRETON RD., DERBY. PHONE: DERBY 47676 (4 LINES). GRAMS: DYNAMO, DERBY
LONDON OFFICE: IMPERIAL BUILDINGS, 56 KINGSWAY, W.C.2. TEL: 0623 HOLBORN





but how about Economic Strength?'

The airline accountant has his own standards of judging an aircraft. From the financial point of view, two features of the Viscount 810/840 are outstanding. It is 50% cheaper than any other four-engined turbo-prop, and seat mile costs will be even lower than earlier Viscounts.

With this low first cost and economy in service goes the passenger appeal which keeps load factors high and ensures profitable operation. The new Viscount 810 already has a cruising speed of 365 m.p.h. The changeover to more powerful Rolls-Royce engines in 1960 will give 400 m.p.h. cruising.

The success of Viscounts is based on two important facts. Passengers prefer them—and they produce healthy airline balance sheets.

VICKERS VISCOUNT 810/840

FOUR ROLLS-ROYCE DART PROPELLER-TURBINE ENGINES

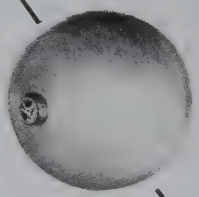
VICKERS-ARMSTRONGS (AIRCRAFT) LIMITED WEYBRIDGE SURREY

TGA AT 574

HIGHER and HIGHER



Portable oxygen breathing equipment specially designed with extra lightweight features for use in high-flying aircraft.



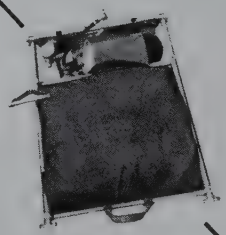
Glass fibre reinforced plastic pressure containers giving high strength/weight ratio, high impact and shatter resistance, dimensional stability, and resistance to a wide variety of chemicals. Suitable for gas and liquid working pressures up to 5000 p.s.i.

The need is for

TOUGHNESS
LIGHTNESS
DEPENDABILITY
COMPACTNESS



Carbon Dioxide Inflation equipment for both airborne and marine dinghies, flotation bags, and life jackets suitable for operating over a wide range of applications and at very wide extremes of temperature.



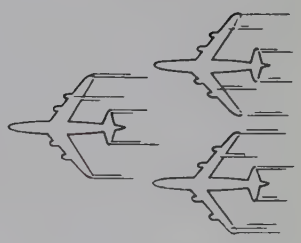
Pre-packed Dinghy stowage equipment specially developed for locked stowage of pre-packed 5-seater, 10-seater and 20-seater dinghies. Is designed to facilitate easy fitment and removal to and from aircraft stowage.

K
Kidde

THE WALTER KIDDE Co LTD

BELVUE ROAD, NORTHOLT, MIDDLESEX
Telephone: WAXLOW 1061

AIR to AIR Missile 5103





NORD-AVIATION

Also manufactures the internationnally known SS10 Missile

Société Nationale de Constructions Aéronautiques
2 à 18, RUE BÉRANGER - CHATILLON-S/S-BAGNEUX
(SEINE) TÉL. ALÉSIA 57-40



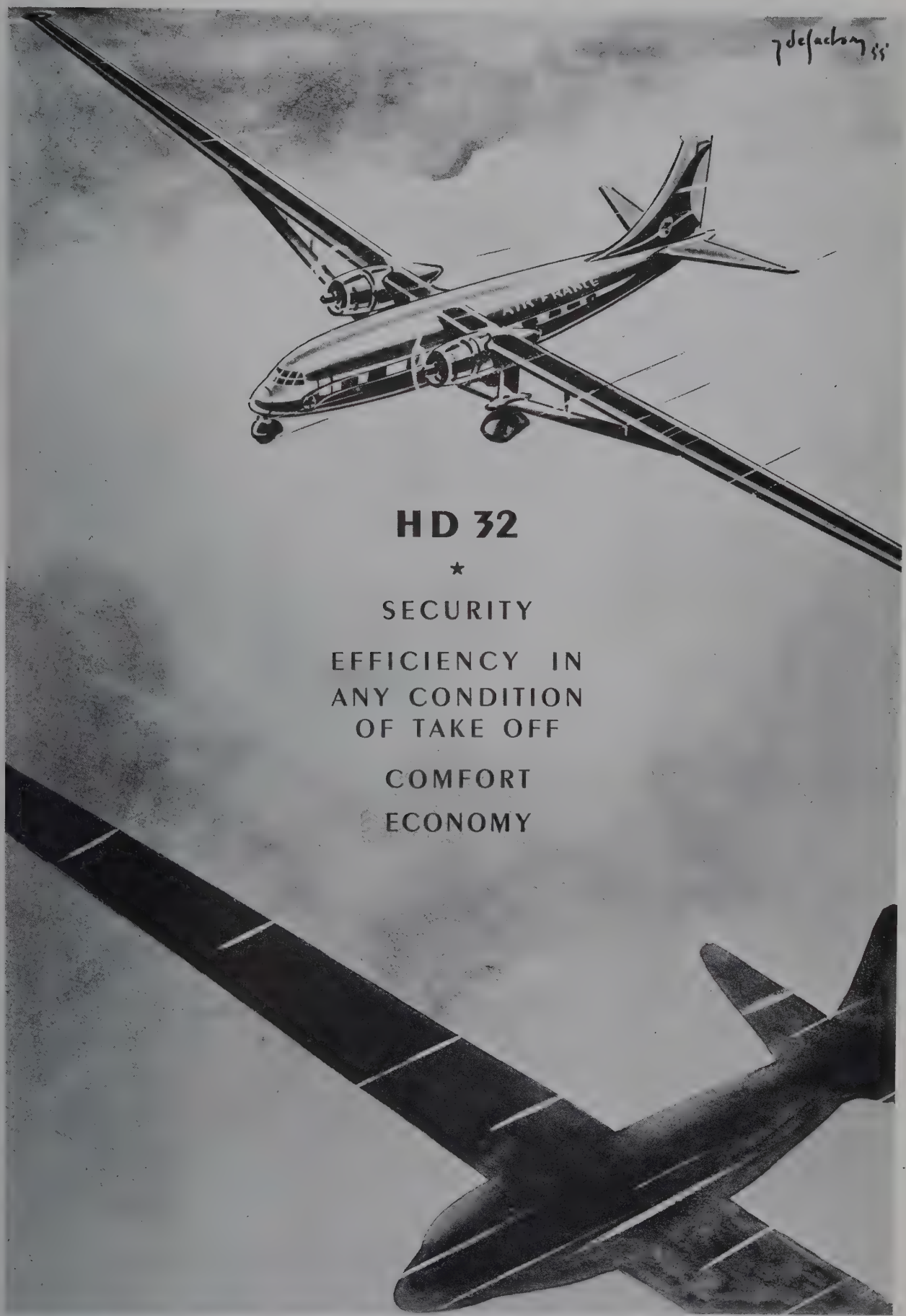
INTAKE TO THE FUTURE

Beyond this screen, which straightens turbulent air flows, Orenda can test run advanced engines in an atmosphere equivalent to 100,000 feet of altitude.

This new high altitude tunnel is another of the major programs at Orenda for research into air-breathing engines over the widest range of speed and altitude.

ORENDA ENGINES LIMITED MALTON, CANADA

MEMBER: A.V. ROE CANADA LIMITED & THE HAWKER SIDDELEY GROUP



HD 32

★

SECURITY

EFFICIENCY IN
ANY CONDITION
OF TAKE OFF

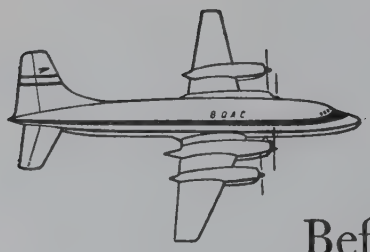
COMFORT

ECONOMY

AVIONS HUREL-DUBOIS

ROUTE DE VERRIÈRES A MEUDON, VILLACOUBLAY - FRANCE
BOITE POSTALE N° 6 A MEUDON - TEL. : OBS. 27-90

74 adv.



Before they take the air...

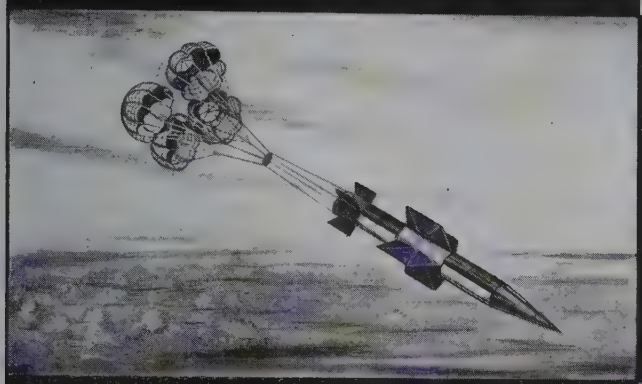
Accurate refuelling and detailed inspection of every aircraft are vital for maximum safety and efficiency during flight. Aircraft refuelling now calls for highly specialised vehicles and equipment offering, amongst other things, large fuel capacity, precise metering equipment, a high rate of delivery and special safety features. It is in the design and development of this equipment that Thompson Brothers have specialised since the very early days of flying. Their equipment meets the service requirements of the latest aircraft using either overwing or pressure fuelling and includes Static Dispensers for use with Ring Mains.

THOMPSON BROTHERS (BILSTON) LTD., BRADLEY ENGINEERING WORKS, BILSTON, STAFFS.
London Office: 17 Surrey Street, Strand, London, W.C.2.



IRVIN





Parachutes

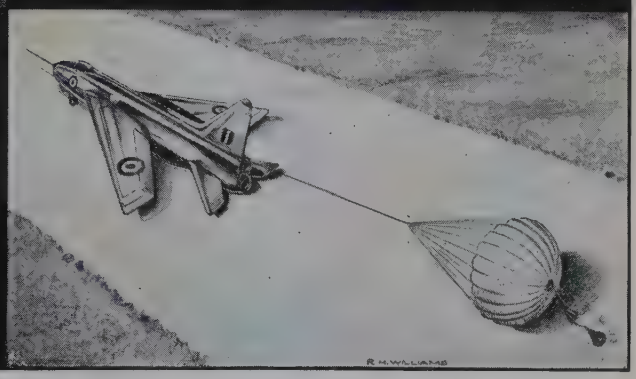
For





Every

Purpose



IRVING AIR CHUTE OF GREAT BRITAIN LTD.
LETCHWORTH, HERTS, ENGLAND

Telephone : Letchworth 888 Telegrams : Irvin, Letchworth

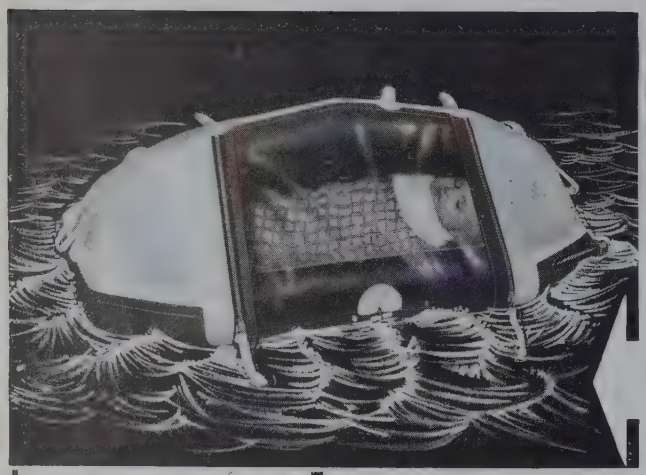
76 adv.

ELLIOT

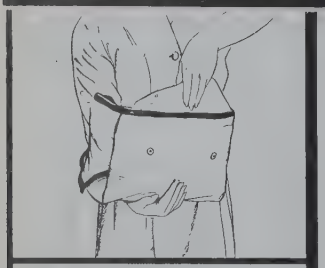
inflatable

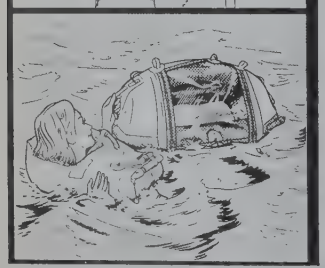
life-jacket





and Babycot





FOR THE SURVIVOR

Flotation is assured.
Protection from marine hazards provided.
Location hastened by the use of new fluorescent materials.

FOR THE OPERATOR

Weight is a minimum.
Bulk is restricted.
Functional Reliability is guaranteed.

FOR THE PURCHASER OR DESIGNER

Lifejackets, Babycots, Liferafts, Escape Chutes, Lifting Bags, Flotation Equipment, either in stock or to your requirements. Consult:—

CORY BROTHERS & CO LTD

(SURVIVAL EQUIPMENT DIVISION)

Head Office:
CORYS' BUILDINGS, CARDIFF
TELEPHONE: 31141
TELEGRAMS: CORY, CARDIFF. TELEX: 49-300

U.K. Enquiries:
8 GREAT TOWER STREET, LONDON, E.C.3
TELEPHONE: MANSION HOUSE 3477
TELEGRAMS: CORY, EASPHONE, LONDON. TELEX: 28498-9

HP5838

Titanine Aircraft Finishes are used for the internal protection of the ***VICKERS*** VANGUARD



The Vickers Vanguard is designed for medium/long range operations. It has two decks — the upper deck with accommodation for up to 115 passengers — the lower providing two cargo holds.

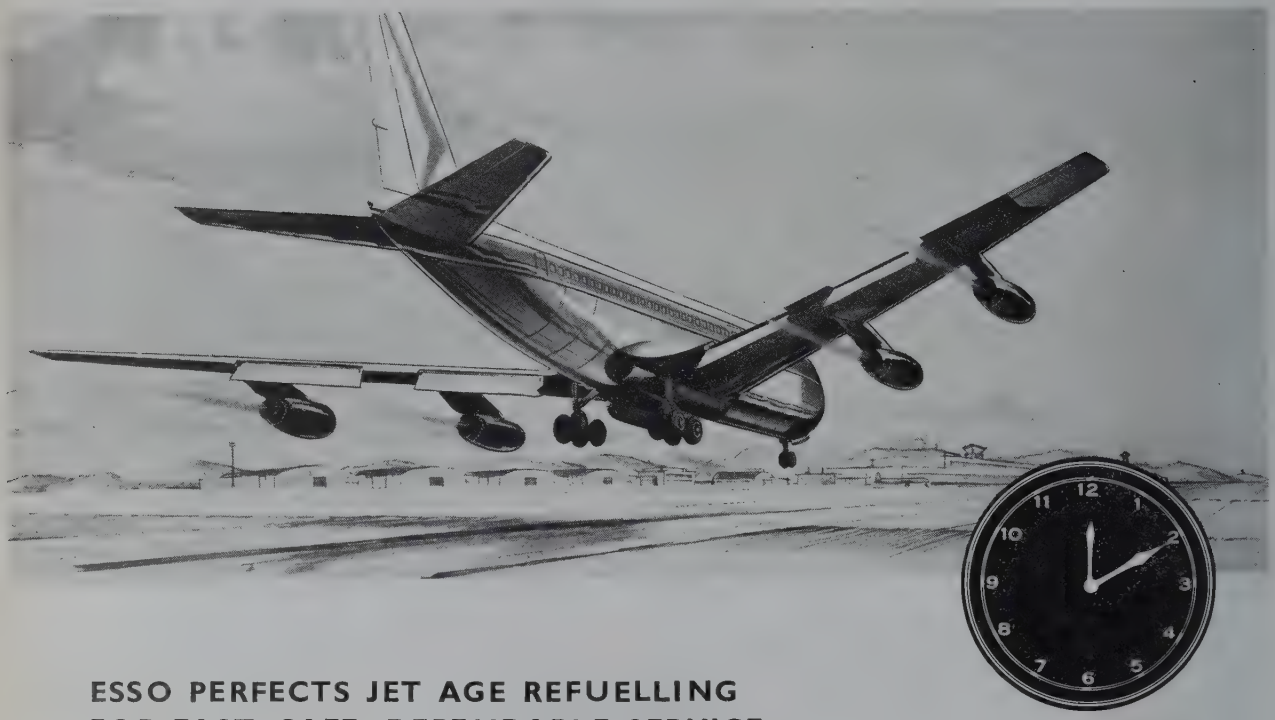
A valuable new development is that two-thirds of the 25,000 lb. pay-load may be taken in freight, if required. This means that the Vanguard can be used to nearly maximum potential during off-peak service.

As with the famous Vickers Viscount, Titanine materials have been selected for finishing the interior of every Vanguard.

TITANINE AIRCRAFT FINISHES

TITANINE LIMITED, COLINDALE, LONDON, N.W.9. COLINDALE 8123 · FACTORIES: LONDON · SURREY · SCOTLAND · ASSOC. COYS.: U.S.A. & HOLLAND

ESSO JET AGE EXPERIENCE IS READY TO SERVE YOU NOW



ESSO PERFECTS JET AGE REFUELLING FOR FAST, SAFE, DEPENDABLE SERVICE

Fast turn-around is essential to profitable airline operations. With the increased fuel capacities of the great new jet airliners, faster refuelling becomes more important than ever before. Anticipating these jet age demands, Esso engineers have perfected *two* basic methods for refuelling large airliners safely—and on schedule.

HYDRANTS—The Esso-developed hydrant refuelling system was first installed 11 years ago. This practical and efficient method has since proved ideal for busy airports. New high-speed hydrant refuelling systems are now being installed to serve the large jet airliners.

NEW REFUELLING TRUCKS—New Esso refuellers feature greater capacity, higher pumping rates, improved filtration and greater mobility—to meet the increased demands of jet age airliners.

These modern refuelling systems are two more examples of Esso leadership in petroleum service for today and tomorrow.

ESSO

AVIATION PRODUCTS



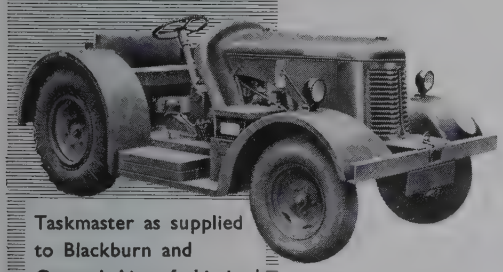
The choice of the Experts...

Blackburn and General Aircraft Ltd. again chose a David Brown Aircraft Towing Tractor for the ground handling of the N.A.39.



DAVID BROWN

EUROPE'S LARGEST MANUFACTURERS OF AIRCRAFT TOWING TRACTORS



Taskmaster as supplied to Blackburn and General Aircraft Limited

'900' TASKMASTER · '900' TURBO TASKMASTER

(ALSO TWIN WHEELED VERSION)

'900' TURBO TASKMASTER WITH AIRCRAFT STARTER AND SERVICING UNIT

DAVID BROWN CONSTRUCTION EQUIPMENT LTD.

A subsidiary of The David Brown Corporation Limited

HANWORTH PARK · FELTHAM · MIDDLESEX **TEL. FELTHAM 5271**

Presenting the

FERRANTI

Miniature Electric Gyro Horizon

for A.C. and/or D.C. operation



A typical control unit incorporating a Transistorised Static Inverter for automatic operation from a D.C. supply in the event of A.C. failure is illustrated. Alternative control units for other applications are available.

The F.H.7 Miniature Artificial Horizon, which is in a 3¼″ S.A.E. Case, can be used either as a primary or as a standby instrument. In this latter role it has been specified for use in Military and Commercial Aircraft. Pitch/Bank methods of control and sealed cases are employed for highest possible accuracy and reliability.

FERRANTI

TRANSISTORISED STATIC INVERTERS, VOLTAGE REGULATORS AND TRANSFORMER RECTIFIER UNITS ARE ALSO AVAILABLE

Write for full information to:-

FERRANTI LTD · AIRCRAFT EQUIPMENT DEPT · MOSTON · MANCHESTER 10
or WESTWICK, BRACKNELL, BERKSHIRE

FGH3

From take-off to touch-down . . .





SAFER...
with SIEBE, GORMAN

OXYGEN APPARATUS

is one of the many major contributions made by Siebe, Gorman to safer flying. Their aircraft oxygen equipment includes a full range of emergency apparatus, regulators, economisers, liquid oxygen convertors, cylinders, fittings and test equipment.

SAFETY BELTS, HARNESS, LIFE BELTS

Typical of the efficiency of this equipment is the Siebe, Gorman Aircraft Safety Belt Type IV. Here, fixing and adjustment are completed in one operation, and a definite lift of the lever gives instant release. Belts of this type—approved by the Air Registration Board—have been supplied to the leading Airlines.

DECOMPRESSION CHAMBERS FIRE FIGHTING EQUIPMENT

Contractors to Admiralty, Ministry of Supply etc.,

Established 1819

SIEBE, GORMAN & CO. LTD.
LONDON
EVERYTHING FOR SAFETY EVERYWHERE

NEPTUNE WORKS, DAVIS RD., CHESSINGTON, SURREY

Telegrams: Siebe, Chessington. *Telephone: Elmbridge 5900*

SG(A)4



PERFECTION in action



Singleness of purpose and years of experience lie behind any apparently effortless performance.

And so it is with springs.

It's taken for granted that Salter Springs will keep on and on, doing their job with smooth precision—almost indefinitely.

But it has taken nearly two centuries of skill and devotion to achieve so great a reputation for reliability that—ironically enough—the greatest compliment paid to Salter Springs is that you can forget them!

FOR TOP PERFORMANCE — SPECIFY

SALTER

THE **ALL-ACTION** SPRINGS

GEO. SALTER & CO. LTD., WEST BROMWICH, ENGLAND

Established 1760

FOR MISSILES

FOR AIRCRAFT

Design & Development

SPECIALISED ELECTRICAL TEST EQUIPMENT

MISSILE HANDLING & COOLING EQUIPMENT

MOBILE AIR COOLING & PRESSURE TEST UNITS

PRESSURISED HELMETS

CABLE CUTTERS

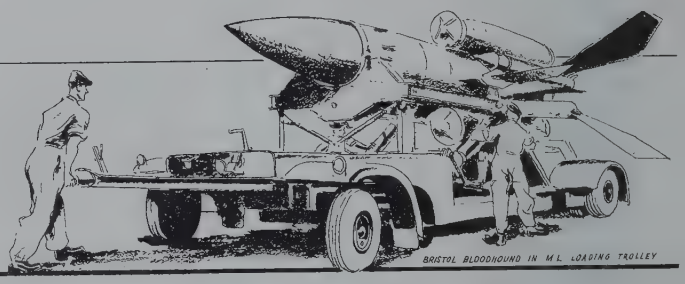
ARMAMENTS

RELEASES

M L

AVIATION CO.
LIMITED

WHITE WALTHAM AERODROME
MAIDENHEAD, BERKSHIRE
Tel: Littlewick Green 248. Grams: "EMELAIR", White Waltham



BRISTOL BLOODHOUND IN M.L. LOADING TROLLEY

A COMPANION VOLUME TO JANE'S ALL THE WORLD'S AIRCRAFT

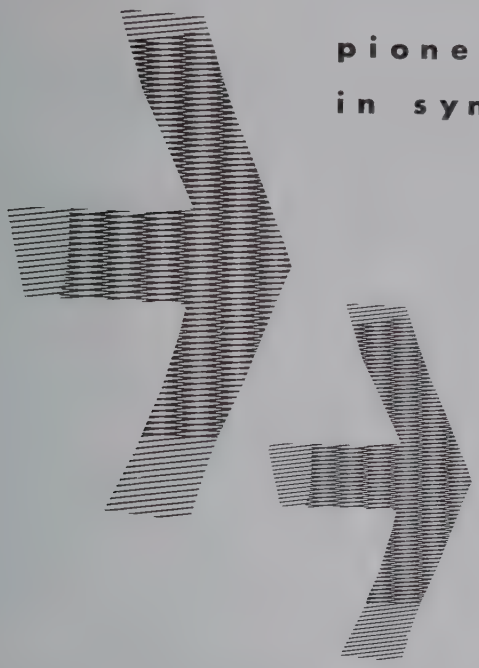
JANE'S FIGHTING SHIPS

Edited by
R. V. B. BLACKMAN, A.M.I.N.A., A.I.Mar.E.

Founded in 1897 Published annually

Complete descriptions, photographs and in many cases diagrams, are given for every ship in every navy in the world.

The details are completely revised every year and are based on information received from official sources and from reliable correspondents throughout the world.



pioneers and leaders
in synthetic flight trainers

-with a service organization
that spans the world

Air Trainers Link Ltd. Aylesbury, England

telephone: Aylesbury 4611/7. telegrams: "Trainair" Aylesbury

Multi-channel automatic recording systems

The Mastertape specially developed for multi-channel recording systems is the only tape available with high polish on the recording surface, background noise being practically non-existent.

Enquiries to :

MSS RECORDING COMPANY LIMITED

COLNBROOK · BUCKINGHAMSHIRE



The MSS Company are the originators of the Mastersound system recognised throughout the world as the most accurate method of sound recording. Used by the Admiralty, General Post Office, Ministry of Supply, the B.B.C., and musicians and technicians everywhere

Showroom and Studio : 21 Bloomsbury Street, London W.C.1. Tel : MUSeum 1600

84 adv.



It all points to Marston

Marston's are specialists in light alloy fabrication, laminated plastics components and flexible tanks for all aircraft applications.

HEAT EXCHANGERS

'MARLITE'* FLEXIBLE FUEL TANKS

** (the new lightweight tank material)*

LAMINATED PLASTIC RADOMES

COMPONENTS FOR GUIDED MISSILES

The Marston design and development organisation (approved by the Ministry of Supply and Air Registration Board) is at the service of customers.

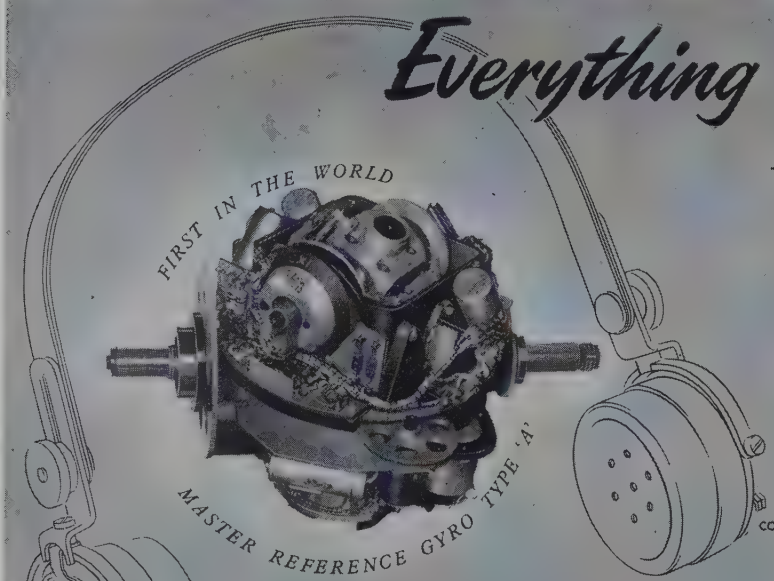
MARSTON EXCELSIOR LIMITED

FORDHOUSES, WOLVERHAMPTON **Tel. 3361**

(A subsidiary company of Imperial Chemical Industries Limited)

MAR. 240

Everything under control



There are few Companies with such varied experience as "Brown's"—designers of the only entirely British gyro compass, first manufacturers in the world of a master reference gyro for Aircraft, and famous in the past for our founder, Mr. S. G. Brown's inventive genius which, for example, made possible the transmission of submarine telegraphy over long distances. Today our unique experience is applied in producing many things, including Guided missile control equipment, High speed recording cameras, Torpedo and radar control gyroscopes, Aircraft pressurised inter-communication amplifiers, Miniature motors and tacho generators, the well-known "Subsig" Echo Sounders and, of course, Brown headphones and telephones. We also cut gears to better than Admiralty Class I specification. Manufactured to the standard of precision that is our hallmark, these "Brown" Products can fairly be described as without equal.

Brown **THE PRECISION PEOPLE**

S. G. BROWN LTD., SHAKESPEARE STREET, WATFORD, HERTS.
Incorporating The Submarine Signal Co. (London) Ltd.
Telephone: Watford 7241. Grams: "Sidbrownix Watford"

A.C. or D.C.? You choose— we supply

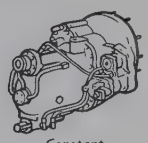
English Electric Aircraft Equipment Division are at the hub of a revolution now going on in aircraft electric systems — the switch from D.C. to constant frequency A.C.

English Electric D.C. equipment — generators, invertors, motors, actuators — have logged thousands of hours flying experience in both military and civil aircraft.

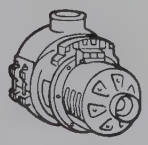
On the A.C. side we are uniquely placed — not only because we are licensed to manufacture the well proved Sundstrand Constant Speed Alternator Drive Unit, but also because we have behind us an organisation unrivalled in the country for its experience with complete A.C. power systems.

The new English Electric Test and Development Laboratories at Bradford are among the finest of their type in the country. They have been established to further our activities in the testing of equipment under simulated high altitudes and extremes of temperature and climatic conditions.

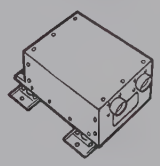
Whatever your aircraft electrical problems, large or small, A.C. or D.C., we have knowledge and experience that will be of value to you. May we help you?



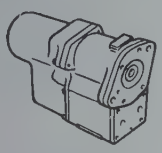
Constant Speed Drives



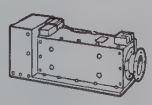
Alternators



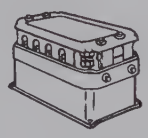
Alternator Control Panels



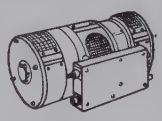
Rotary Actuators



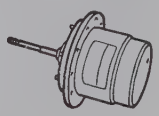
Transformer Rectifier Units



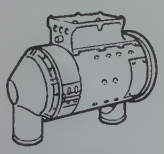
Circuit Breakers



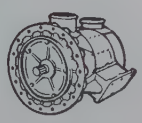
Invertors



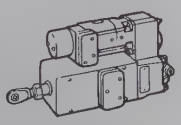
Pump Motors



Starter Generators



Generators



Linear Actuators

'ENGLISH' ELECTRIC
aircraft equipment

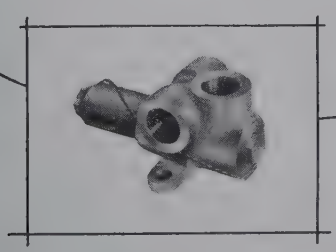
THE 'ENGLISH' ELECTRIC COMPANY LIMITED · **AIRCRAFT EQUIPMENT DIVISION** · PHOENIX WORKS · BRADFORD

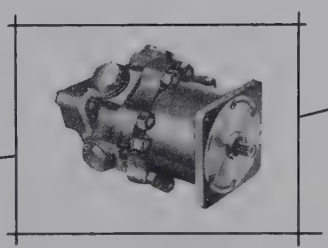
INTEGRAL

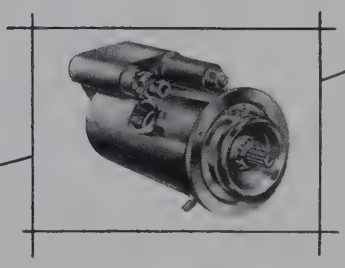
Hydraulics

for **aircraft and missile systems . . .**

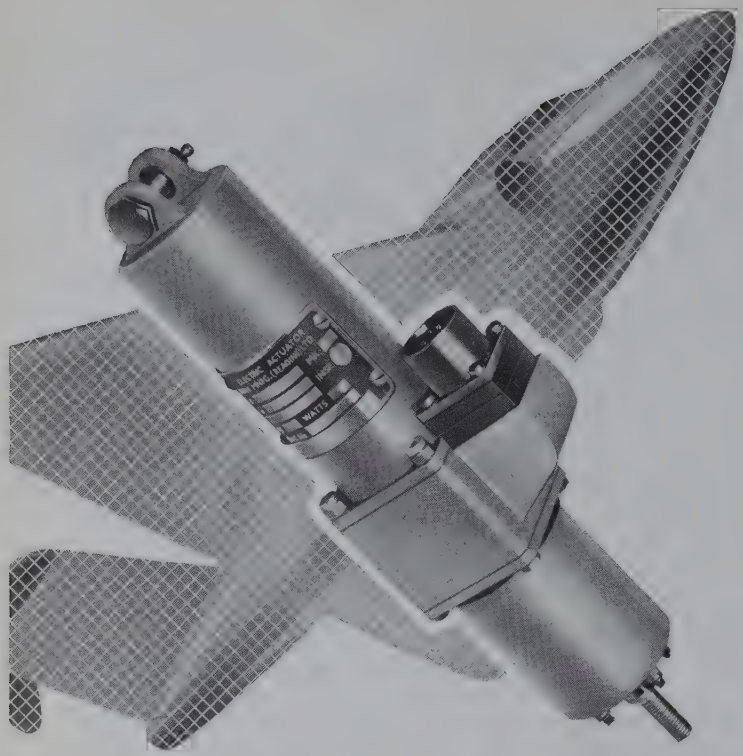
including PUMPS, MOTORS
CONSTANT-SPEED UNITS
POWER PACKS
CONTROL, CUT-OUT, RELIEF
and SEQUENCE VALVES
HYDRAULIC FUSES







INTEGRAL LIMITED, BIRMINGHAM ROAD, WOLVERHAMPTON, ENGLAND



. . . quality and endurance

. . . above all . . .

are characteristic of all aviation accessories bearing the trade mark of Western Manufacturing (Reading) Ltd. Foremost amongst the problems solved by us are those dealing with remote control. Western's Electric Actuators are relied upon by many leading Aircraft Constructors.

WESTERN MANUFACTURING (Reading) LTD.

THE AERODROME · READING · BERKSHIRE

Telephone: SONNING 2351 Grams: HAWK, READING *EJ100 Mk 20*

High speed and scientific cine-cameras

Vinten

for flight test and research photography

Combat, High Speed and Scientific Cameras

A range of small, reliable 16 mm. Cameras consisting of:—

(i) The Vinten G.90. Combat Camera–as supplied to the R.A.F. and other Air Forces for evaluation of air to air and air to ground attacks.

(ii) A High Speed Camera – giving speeds up to 100 f.p.s. with visual time scale on film and event marker. Now in use in connection with missile development.

(iii) Scientific Mk. I. Camera – A simple Camera with speeds of 8, 16 or 24 f.p.s. and/or single shot operation with interchangeable lenses.

(iv) Scientific Mk. II. Camera – A more elaborate instrument fitted with a rotating reflex shutter and a turret of three lenses. Operating speeds as for Mark I.

Reconnaissance Camera

The Vinten F. 95. 70 mm. Camera specially designed for the R.A.F. for low altitude photography from high speed aircraft. Can be operated at 4 or 8 f.p.s. or single shot. Now in service with Air Forces throughout the world.

Instrumentation Camera

A fully automatic camera providing permanent recordings on 35 mm. film during flight of all aircraft instrument panel readings.

High Speed Recording Camera

This special camera will give high definition pictures at film speeds up to 275 frames per second thus providing accurate frame by frame analysis of high speed motion.

Take-Off Camera

An exclusive Vinten development for the evaluation of aircraft performance on take-off or landing giving distance/time, distance/height curves, ground speed, rate of climb, acceleration figures etc.

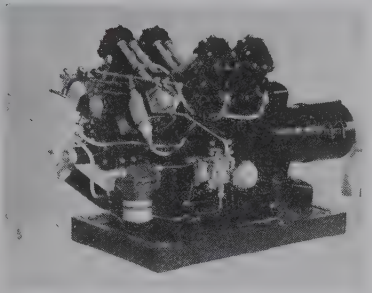
Vinten specialise in every type of cine and still camera equipment for the aircraft industry. Further and more detailed information will gladly be sent on request.

W. VINTEN LIMITED, North Circular Road, Cricklewood, N.W.2. Gladstone 6373 (Export enquiries to Cinematograph Export Ltd.)

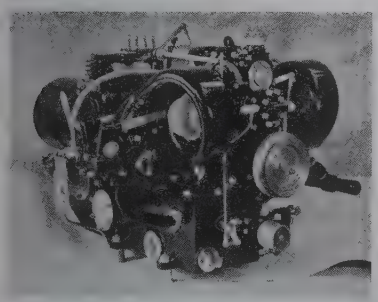
ABC

Airborne Auxiliary Power Plants

Designed and produced for the Ministry of Supply



15 H.P. Power Unit driving 6 KW – 28 Volt D.C. Generator for installation in the "Beverley" aircraft and similar duties.



The 5 H.P. Power Unit driving through clutch and gearbox.

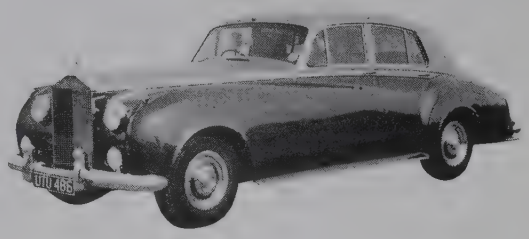
1. Dynamo=25 amps at 12 volts.
2. Petrol Pump 2,500 galls per hour.
3. Bilge Pump 2,500 galls per hour.
4. 2 Compressors–charging 400 cub. ins. to 200 lbs. per sq. in. in 2½ mins.

For installation in "Sunderland" and other Flying Boats.

A.B.C. MOTORS Ltd.

Walton-on-Thames, Surrey, England

Phone - 774/775 Grams' - "Revs"



Suppliers to

ROLLS-ROYCE

The Best Car in the World

YES

EATONIA

BEARINGS & BUSHES

YORKSHIRE ENGINEERING SUPPLIES LIMITED

"EATONIA" BRONZE FOUNDRIES, LEEDS 12

Telephone: Leeds 638234/638291 Telegrams: Yes, Leeds 12

A companion volume to

JANE'S ALL THE WORLD'S AIRCRAFT

WORLD RAILWAYS

Edited by

HENRY SAMPSON

THE STANDARD REFERENCE BOOK OF RAILWAY OPERATION AND EQUIPMENT

The information given is world wide in scope and covers:— the operation and equipment of all public service and many industrial railways; the composition and activities of the major locomotive and rolling stock manufacturers; up-to-date information on all underground railways, plus illustrated descriptive articles on aspects of topical interest to everyone concerned with railways.

WORLD RAILWAYS is designed to meet the needs of railways officials, engineers, manufacturers and builders of equipment, students, etc.

12 G. SAFETY BELT 12 oz.

A NEW "MILLS" PRODUCT

LAP TYPE - ME/2095

Approved by Air Registration Board (Ref. No. E.3993)

- *Designed to stand 12 g. this improved Passenger Seat Belt, having a lightweight quick-release with nylon webbing straps, complies with the latest specification requirements.*
- *Weight of complete Belt only 12 ounces.*
- *Webbing dyed to suit aircraft colour scheme.*

SAFETY HARNESSES FOR PILOTS

Approved Types for all Aircraft

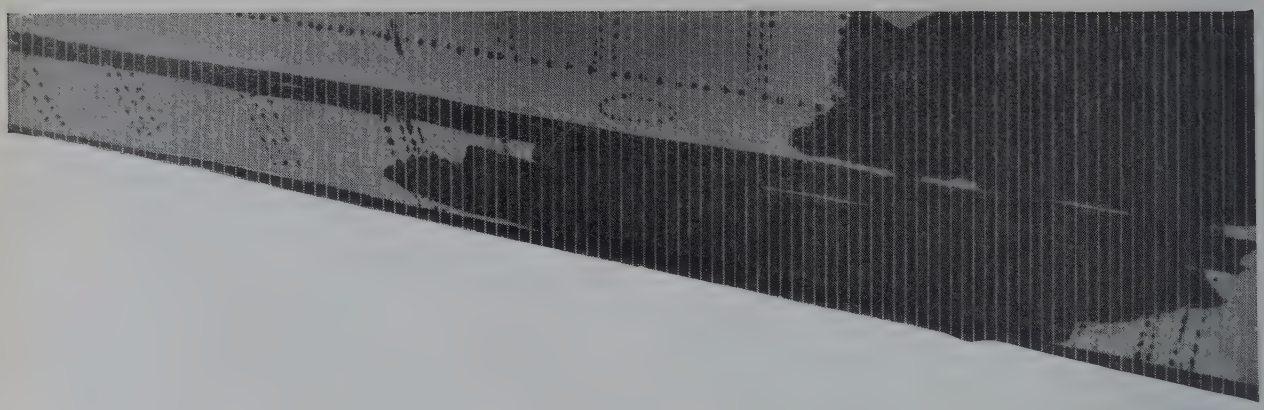
Details and prices upon application to:—

THE MILLS EQUIPMENT CO., LTD.,

56, VICTORIA STREET, WESTMINSTER, LONDON, S.W. 1.

Telephone: VICTORIA 9271-2-3 (Extn. No. 13)

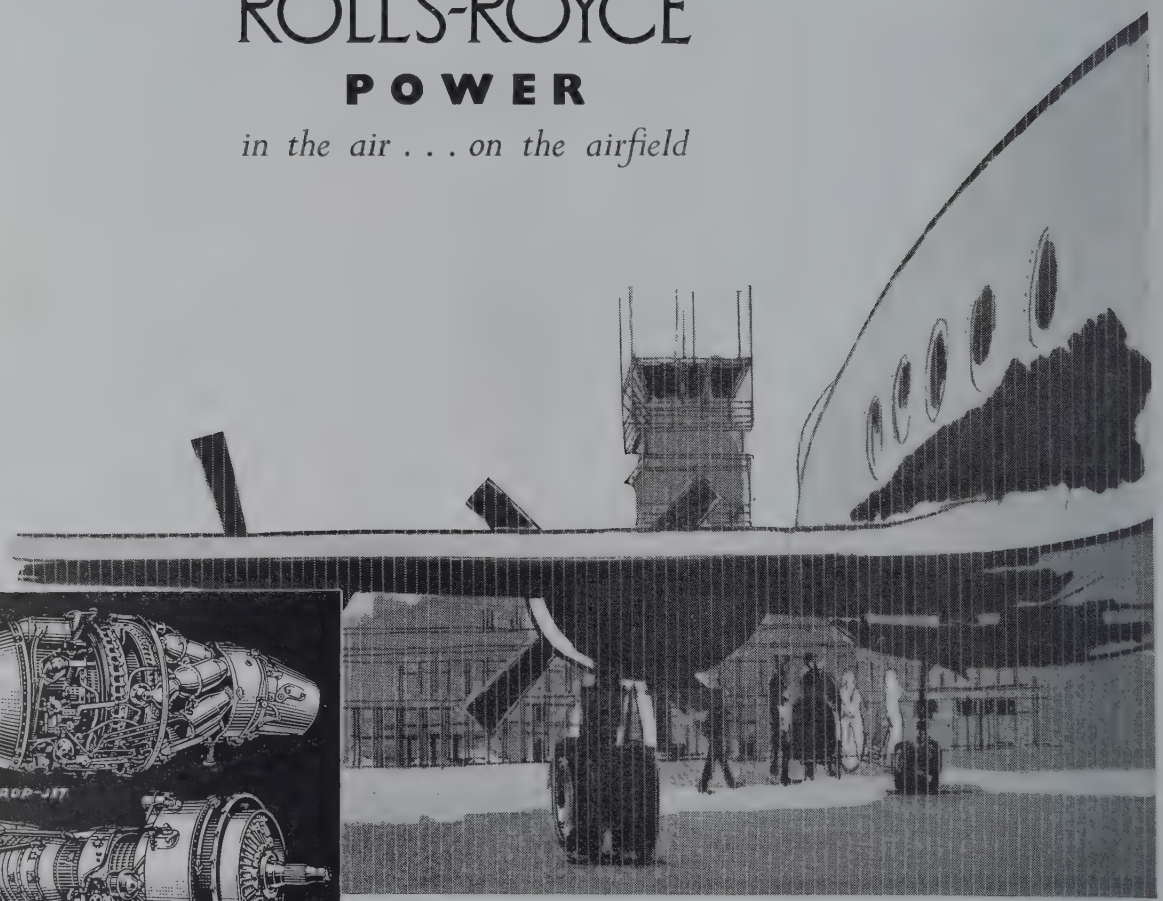
Telegrams: EFFIGIES, PHONE, LONDON.

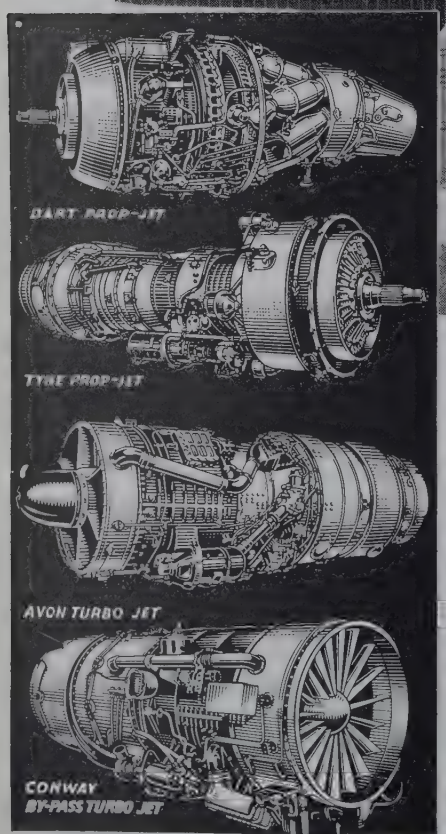


ROLLS-ROYCE

POWER

in the air . . . on the airfield





Rolls-Royce are unique in being the only aero engine manufacturers in the world making four different types of gas turbines for civil and military aircraft. Aviation is also being served by Rolls-Royce petrol engines in airfield ground equipment and by diesel engines which power civil engineering equipment in the construction and development of airfields. Nuclear and rocket power units are also being developed by Rolls-Royce engineers.



Airfield Crash Tender on a Thorneycroft Chassis powered by a Rolls-Royce Petrol Engine.



Pethow "Power-Puller" Ground Power Unit powered by a Rolls-Royce Diesel Engine.

ROLLS-ROYCE LIMITED,
DERBY, ENGLAND.

AERO ENGINES · MOTOR CARS · DIESEL AND PETROL ENGINES · ROCKET MOTORS · NUCLEAR PROPULSION



JANE'S ALL THE WORLD'S AIRCRAFT

1958-59

FOUNDED BY FRED T. JANE IN 1909

COMPILED AND EDITED BY

LEONARD BRIDGMAN

ASSISTANT COMPILER :

JOHN W. R. TAYLOR

NEW YORK:

THE McGRAW-HILL BOOK COMPANY, INC.

Copyright © 1958 Jane's All The World's Aircraft Publishing Co. Ltd.

Printed in Great Britain

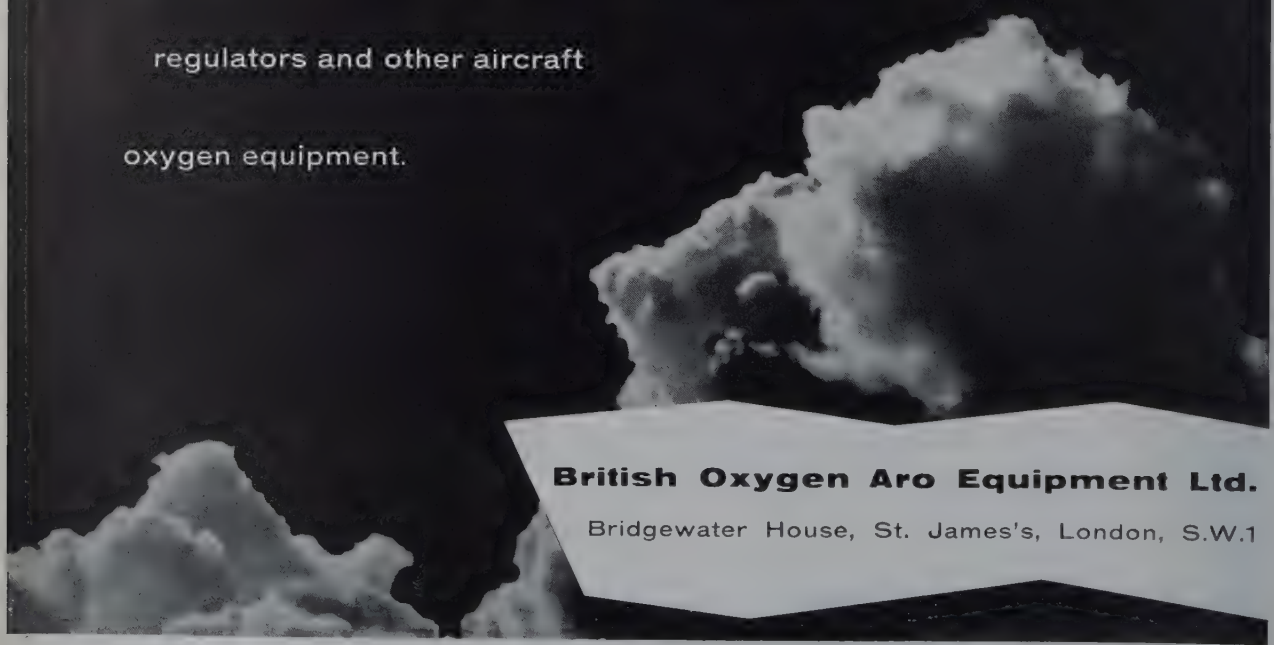
Contra Costa County
Library

B·O·A·E –

a Service to Aviation

BRITISH OXYGEN ARO EQUIPMENT

combines the skills and experience of British Oxygen and The Aro Equipment Corporation of the U.S.A. to form an outstanding forward-looking team in the service of aviation. B.O.A.E. specialises in liquid oxygen converters, oxygen regulators and other aircraft oxygen equipment.



British Oxygen Aro Equipment Ltd.

Bridgewater House, St. James's, London, S.W.1

CONTENTS

PAGE

PREFACE – – – – – – – – – – – – – – – – – i
INDEX OF AIRCRAFT AND MANUFACTURERS – – – – – – – – – – – iii
INDEX OF ROTARY WING AIRCRAFT AND MANUFACTURERS – – – – – – – – xvii
INDEX OF ENGINES AND MANUFACTURERS – – – – – – – – – – – xix

MILITARY AVIATION

MARKINGS OF THE AIR FORCES OF THE WORLD – – – – – – – – – – 1

CIVIL AVIATION

INTERNATIONAL CIVIL AIRCRAFT MARKINGS – 8
INTERNATIONAL CIVIL AVIATION ORGANIZATION (I.C.A.O.) – – – – – – 9
INTERNATIONAL AIR TRANSPORT ASSOCIATION (I.A.T.A.) – – – – – – 9
FEDERATION AERONAUTIQUE INTERNATIONALE (F.A.I.) – – – – – – 11
OFFICIAL WORLD'S RECORDS RECOGNISED BY F.A.I. – – – – – – – 12

CIVIL AIRLINE OPERATORS

ADEN – – – – – – – 13
AFGHANISTAN – – – – – – 13
ALASKA – – – – – – – 13
ALGERIA – – – – – – – 13
ARGENTINA – – – – – – 13
AUSTRALIA – – – – – – 14
AUSTRIA – – – – – – – 15
BAHRAIN – – – – – – – 15
BELGIUM – – – – – – – 15
BOLIVIA – – – – – – – 15
BORNEO – – – – – – – 15
BRAZIL – – – – – – – 16
BRITISH CENTRAL AFRICA – – – – 17
BRITISH EAST AFRICA – – – – 17
BRITISH GUIANA – – – – – 17
BRITISH HONDURAS – – – – – 17
BRITISH WEST AFRICA – – – – 17
BRITISH WEST INDIES – – – – – 18
BULGARIA – – – – – – – 18
BURMA – – – – – – – 18
CAMBODIA – – – – – – 18
CANADA – – – – – – – 18
CEYLON – – – – – – – 19
CHILE – – – – – – – 19
CHINA – – – – – – – 20
COLOMBIA – – – – – – 20
COSTA RICA – – – – – – 20
CUBA – – – – – – – 20
CYPRUS – – – – – – – 21
CZECHOSLOVAKIA – – – – – 21
DENMARK – – – – – – – 21
DOMINICAN REPUBLIC – – – – 21
ECUADOR – – – – – – – 21
EGYPT – – – – – – – 21
EL SALVADOR – – – – – – 21
ETHIOPIA – – – – – – – 21
FIJI ISLANDS – – – – – – 21
FINLAND – – – – – – – 21
FRANCE – – – – – – – 22
FRENCH EQUATORIAL AFRICA – – – 22
FRENCH GUIANA – – – – – 22
GERMANY – – – – – – – 22
GHANA – – – – – – – 23
GIBRALTAR – – – – – – 23
GREAT BRITAIN – – – – – – 23
GREECE – – – – – – – 26
GUATEMALA – – – – – – 26
HAITI – – – – – – – 26
HAWAIIAN ISLANDS – – – – – 26
HONDURAS – – – – – – – 26
HONG KONG – – – – – – 26
HUNGARY – – – – – – 26
ICELAND – – – – – – – 26
INDIA – – – – – – – 27
INDO CHINA – – – – – – 27
INDONESIA – – – – – – – 27
IRAN – – – – – – – 27
IRAQ – – – – – – – 27
IRELAND – – – – – – – 27
ISRAEL – – – – – – – 28
ITALY – – – – – – – 28
JAPAN – – – – – – – 28
JORDAN – – – – – – – 28
KOREA – – – – – – – 28
KUWAIT – – – – – – – 28
LEBANON – – – – – – – 28
LIBERIA – – – – – – – 29
MADAGASCAR – – – – – – 29
MALAYA – – – – – – – 29
MALTA – – – – – – – 29
MEXICO – – – – – – – 29
MOROCCO – – – – – – – 30
NEPAL – – – – – – – 30
NETHERLANDS – – – – – – 30
NETHERLANDS ANTILLES – – – – 30
NETHERLANDS NEW GUINEA – – – 30
NEW CALEDONIA – – – – – 31
NEW GUINEA – – – – – – 31
NEW ZEALAND – – – – – – 31
NICARAGUA – – – – – – 31
NORWAY – – – – – – – 31
PAKISTAN – – – – – – – 31
PANAMA – – – – – – – 32
PERU – – – – – – – 32
PHILIPPINES – – – – – – 32
POLAND – – – – – – – 32
PORTUGAL – – – – – – – 32
PORTUGUESE AZORES – – – – – 32
PORTUGUESE EAST AFRICA – – – – 32
PORTUGUESE INDIA – – – – – 32
PORTUGUESE TIMOR – – – – – 32
PORTUGUESE WEST AFRICA – – – – 32

CIVIL AIRLINE OPERATORS—*continued*

PAGE

Puerto Rico – 33
Rumania – 33
Saudi Arabia – 33
Scandinavia – 33
South Africa – 33
South West Africa – 33
Soviet Union – 33
Spain – 33
Sudan – 34
Sweden – 34
Switzerland – 34
Syria – 34
Tahiti – 34
Taiwan (Formosa) – 34
Thailand – 34
Tunisia – 34
Turkey – 35
Uruguay – 35
United States of America – 35
Venezuela – 40
Vietnam – 40
Yugoslavia – 40

AEROPLANES

Some First Flights made during period September 1, 1957—August 31, 1958 – 42
Argentine Republic – 43
Austria – 46
Belgium – 46
Brazil – 47
British Commonwealth
Great Britain – 50
Australia – 117
Canada – 121
India – 131
Bulgaria – 132
Chile – 132
China – 133
Czechoslovakia – 133
Egypt – 138
Finland – 139
France – 142
Germany – 174
Hungary – 184
Indonesia – 185
Italy – 187
Japan – 200
Netherlands – 203
Philippine Republic – 207
Poland – 208
Portugal – 214
Rumania – 214
Soviet Union – 216
Spain – 235
Sweden – 242
Switzerland – 247
Turkey – 248
United States of America – 249
Yugoslavia – 387

GUIDED MISSILES

British Commonwealth
Great Britain – 392
Australia – 397
Canada – 397
France – 398
Italy – 401
Japan – 402
Soviet Union – 403
Sweden – 406
Switzerland – 407
United States of America – 408

GAS-TURBINE ENGINES

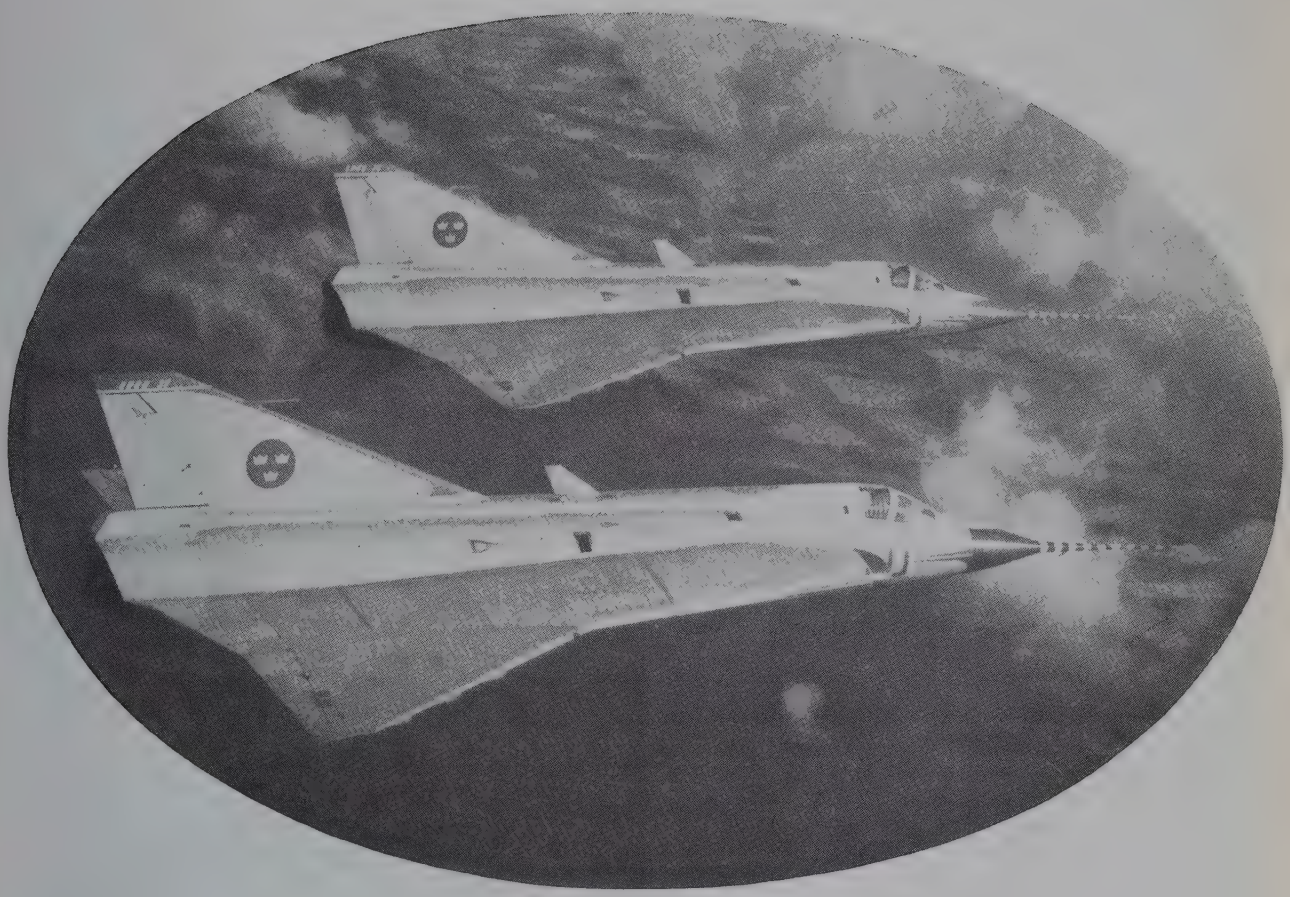
Belgium – 430
British Commonwealth
Great Britain – 431
Canada – 459
France – 462
Germany – 471
Italy – 472
Japan – 474
Poland – 474
Soviet Union – 475
Sweden – 475
United States of America – 476

PISTON ENGINES

Great Britain – 494
Czechoslovakia – 504
France – 506
Germany – 509
Italy – 510
Poland – 511
Soviet Union – 512
Spain – 513
United States of America – 516

AIRSHIPS

United States of America – 530



Ten vital facts about the SAAB-35 "Draken"

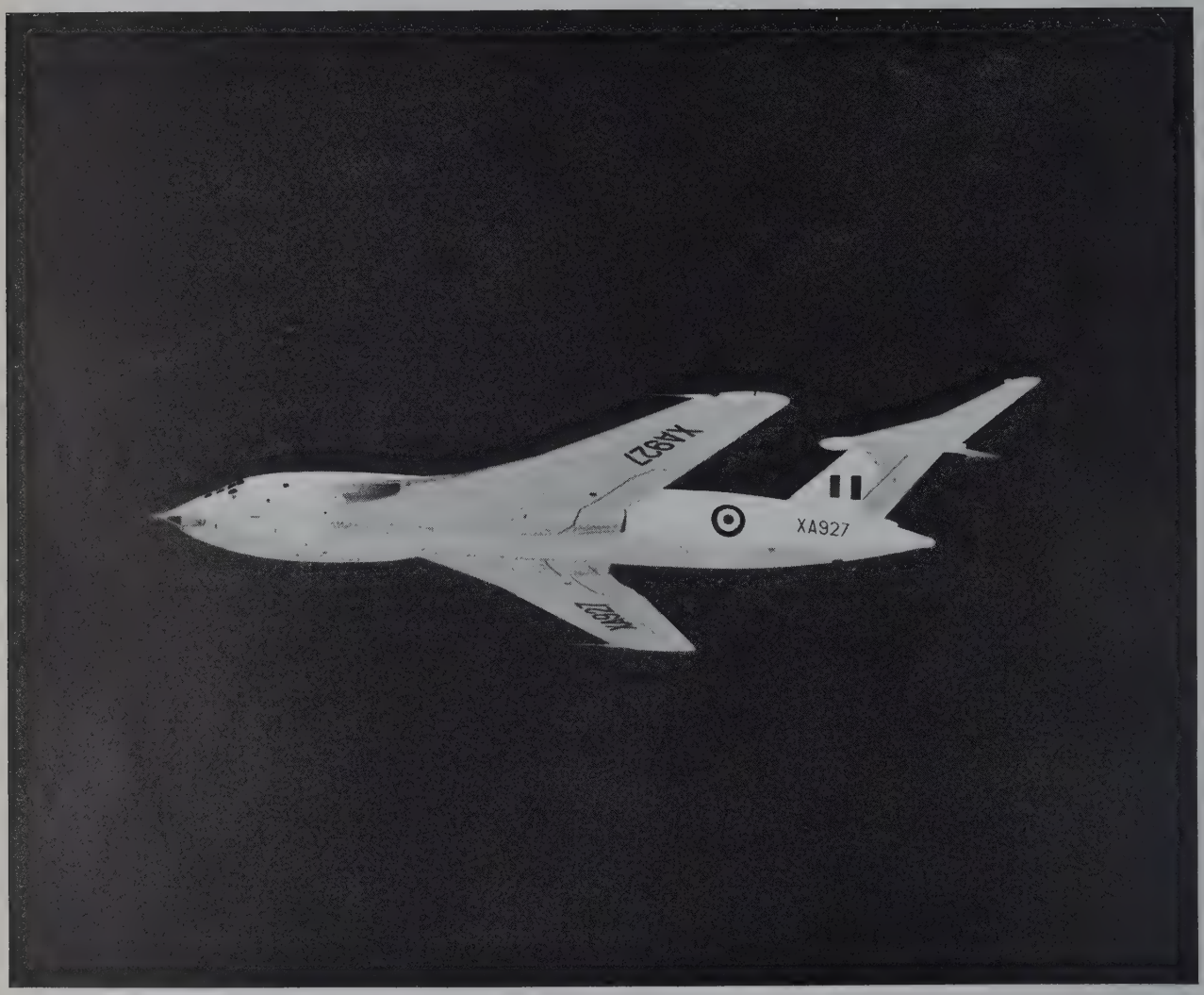
1. It is already in quantity production as the Swedish Air Force's new standard combat aircraft.
2. It has a top speed close to Mach 2 and very impressive climb performances.
3. It has a greater useful speed range than any other aircraft.
4. It can operate from smaller and more shrouded airfields than any other supersonic fighter.
5. It has full radar and navigation equipment for all-weather operations.
6. It is equipped with the most modern fire-control equipment for collision-course tactics.
7. It is equally suitable for interception and ground attack purposes. In the interceptor role it carries air-to-air rockets or guided missiles, and heavy-calibre guns. For ground attack use, it carries a heavy load of air-to-ground rockets or bombs.
8. It is designed for economical production without the use of highly expensive tooling or specialized heavy machinery.
9. It has been developed by a large industrial enterprise with more than 8,000 employees—including 1,500 engineers—and the most modern technical resources.
10. It is backed by 10 years of experience in large scale production of high-speed jet fighters.

SAAB-35

SAAB

SVENSKA AEROPLAN AKTIEBOLAGET • (SAAB AIRCRAFT COMPANY) • LINKÖPING • SWEDEN

VICTOR



Another Victor, painted a distinctive anti-flash white, enters service. This crescent-winged V-bomber is being flown at height by its Royal Air Force crew.

IN SQUADRON SERVICE WITH THE R.A.F.

HANDLEY PAGE

RADLETT · LONDON · READING

PREFACE

TRADITIONALLY, the Preface of "All the World's Aircraft" provides the opportunity to present a brief summary of the contents and at the same time to accent some of the more interesting statistics of the new volume.

In a total of 532 pages, the Aeroplane Section occupies 349 pages and carries a total of 762 illustrations, 374, or nearly 50 per cent. are new. The Missile Section, which in the last edition comprised seven pages of tabular information and five pages of illustrations, has, this year, been remodelled to conform to the standard presentation found in the other sections and now covers 36 pages and includes 73 illustrations, all of which are new.

The Aero-Engine Section is made up of a total of 99 pages, of which 65 are devoted to gas-turbine engines and rocket power-plants and 37 to piston engines. The section as a whole has 151 illustrations, of which 54 are new.

This edition has proved to be no exception in the amount of revision needed in order to present the current situation in the World's aeronautical production picture. As in all previous volumes the amount of new material added, plus the extent of revision needed to bring up to date information carried forward from the previous years volume, has called for the complete re-setting of all the text. The development potential and greater serviceability of the modern aeroplane and aero-engine has resulted in many a well-known aircraft type or engine model becoming something of a repetitive feature, but in very few instances is it possible to carry forward previously-published information without augmentation and/or modification. Once information does become static it is probably time to consider its elimination. In a volume of this nature it is essential to preserve a balance with the "old" and the new in order to keep the size of the volume within both practical and economic limits. So long as an aeroplane (or engine) remains in production or is in widespread use it qualifies for inclusion in the current volume. Despite some extensive deletion of obsolescent material, the addition of much new and important information has resulted in this volume being some 44 pages bigger than last years' edition. Should it be felt that some items have been curtailed or eliminated unfairly, it should be pointed out that "All the World's Aircraft" is an annual publication and that the Index not only covers the contents of the current edition but also includes full references to the contents of the previous nine editions.

As befits the size of its industry, the United States occupies in this edition a total of 190 pages; 137 in the Aeroplane Section, 19 in the Guided Missiles and Test Vehicles Section, 31 in the Aero-Engine Section, and the only 3 pages in the Airship Section. Great Britain, with 111 pages—67 in the Aeroplane Section, 6 in the Guided Missiles Section, and 38 in the Aero-Engine Section—takes its customary second place, while France with a total of 47 pages comes third in order of importance.

Russia with 19 pages in the Aeroplane Section and 3 in the Missile Section comes a rather poor fourth. Although considerable revision of the Russian Aeroplane section has resulted in the addition of 5 pages as compared with last year, not much that is completely new has been incorporated. The annual Military Display at Tushino which in the past has been used to show off the latest military aircraft was cancelled in 1957 and was but a shadow of its former grandeur in 1958, with practically no Air Force participation. Since closing the Russian pages for press, however, confirmation has been received that a new six-jet delta-wing bomber with intercontinental range and a Mach 2 performance is now going into operational service as a replacement for the subsonic "Bison." The new aircraft has been given the N.A.T.O. code-name "Bounder," but no other information is available.

This edition is being published at a time when the World's airlines are poised on the threshold of the so-called Jet Age. Some 450 large jetliners are on order for delivery in 1959 and 1960. Six U.S. and six international trunk lines will be operating jet airliners by the end of 1959, and all twelve U.S. trunk lines and some twenty international airlines plan to place jets in service on all their major routes in 1960. The first trickle of deliveries of the new jetliners began in 1958 and a new "first" was recorded for Great Britain with the inauguration by B.O.A.C. of scheduled jet service across the Atlantic with the Comet 4, closely followed by Pan American World Airways with the Boeing 707.

Some 250 or more turboprop-powered airliners are also on order for delivery in 1959 and 1960, but it is well to recall that, at the time of writing, more than 370 turboprop airliners were in World-wide service, and all of them were of British design and manufacture. The six-year British turboprop monopoly is due to end before the end of 1958 with the entry into service of the Rolls-Royce Dart engined Fairchild/Fokker F.27 and the Lockheed Electra. But so far as the Turboprop Age is concerned, this began in 1953 when British European Airways inaugurated scheduled passenger services with the Vickers Viscount, while the first scheduled trans-Atlantic turboprop service was begun by British Overseas Airways with Bristol Britannias in December, 1957.

The production of American piston-engined airliners ceased in 1958 with the final deliveries to airline customers of the DC-7 Super Constellation and Convair 440, but lest it is imagined that the Jet Age spells the end, particularly in the United States, of the "old order," it is interesting to quote an American estimate that from one-third to one-half of all aircraft operated by American airlines in 1962 will still be piston-engine-powered.

The conflict between military and political opinion regarding the future of manned military aircraft, begun with the 1957 British White Paper on Defence,

is still unresolved. It is significant that America, with its vast financial and technical and technological resources and its considerable practical experience with a variety of missiles systems, is still continuing the development and production of manned aircraft of advanced design—it calls them "weapons systems"—parallel with its military missile programmes.

The year just passed has seen space flight develop from science fiction to scientific fact. American satellites have followed the Russian sputniks into orbit, and one of them is expected to continue circling the Earth for 200 years. Even more spectacular have been the U.S.A.F.'s Moon probes, the second of which might have given us a first close look at the Earth's natural satellite but for a tiny error in its launching angle.

Already much has been learned about conditions in interplanetary space, and vehicles are being developed which will enable man to follow the path of the sputniks. First of these will be a highly-developed manned aeroplane, the North American X-15, but true space vehicles are on the drawing boards of several U.S.—and presumably Russian—design teams.

Meanwhile, the military missiles from which these space projects have been born are beginning their encroachment into service operations which was foreshadowed last year. In Britian, Bomber Command has its first Thor (an American I.R.B.M.), and Fighter Command its first Bloodhound surface-to-air guided weapons. In America, the great Atlas ballistic missile is progressing beyond the testing stage to production as the first of the so-called "ultimate weapons."

This progress is reflected in the size of the Missile Section in this edition. Many well-known names of aircraft manufacturers will be found to be duplicated in this section. Missile production in the United States, amounting in the case of some of the more prominent manufacturers to as much as from 20 to 30 per cent. of total military sales, is resulting in not only a contraction but a revolution in the aircraft industry. Missiles are smaller and do not need so much space nor so many men to build them. On the other hand, a new segment of industry concerned with the missile guidance and related systems is now growing up as fast as electronics technicians can be trained and employed. To cite an example of the current trend, peak employment in the Lockheed Aircraft Corporation was 62,000 in 1957. By the middle of 1959 this is expected to be down to 45,000 in spite of the fact that the company's Missiles Systems Division will in the same period have grown from 6,300 to 11,600. Airframe manufacturers are also meeting with increasing competition from outside the aircraft industry in the missile guidance and control business. The extent to which the U.S. aircraft industry is affected by revolutionary changes which are taking place to-day is brought home by the news that the Aircraft Industries Association is seeking for itself a new name which will reflect the changing character of the aviation business, with emphasis on missile work and space technology.

The British aircraft industry, which has since the war done export business valued at nearly £750 million, is also faced with the uncertainty that confronts the major aircraft manufacturing countries. Although the conventional air weapon is far from being obsolete, as the White Paper would have us believe, the run-down of some current military contracts is leaving many firms, traditionally suppliers of first-line aircraft to the Royal Air Force, with the need to adapt their resources to wider fields, and in this respect the industry is fully alive to its responsibilities. It could, however, benefit from a more determined official policy regarding the nature and scope of its future rôle.

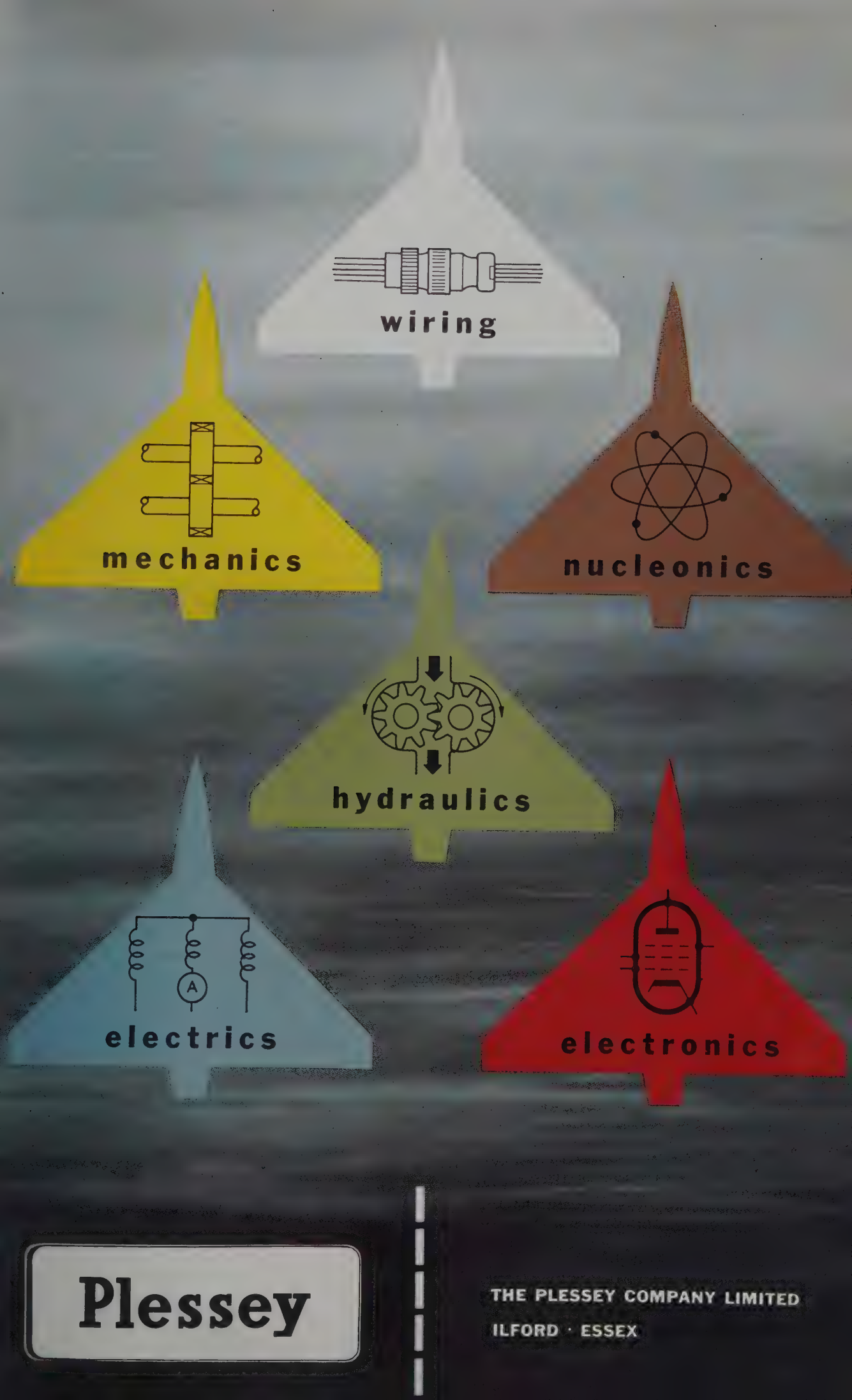
In rounding off the task of compilation of the 1958-59 edition, I would like once again to thank those of my friends who have assisted me in various ways. First, I must acknowledge the invaluable help of Mr. John Taylor, whose industry and encyclopaedic knowledge of World aviation has been of inestimable value in the preparation of this volume. I also thank Mr. C. B. Cynk for his help and guidance in matters concerning Polish aviation, and Signor Vico Rosaspina for his greatly appreciated advice in connection with the Italian aircraft industry. Finally, to Messrs. Warren Bodie, Gordon Williams, Clay Jenssen, Robert Archer and Howard Levy, all photographers of outstanding merit, I offer my sincere thanks for their generous co-operation. Their photographs do much to provide added interest to the American pages.

. . . . . .

This volume will be current through most of 1959, which gives me an opportunity to mention that it was in 1909 that the first edition of Jane's was published. Although we will not be able to celebrate our 50th anniversary until the publication of the 1959-60 edition towards the end of 1959, I feel that it will not be considered out of order for me to make this brief reference to our coming Jubilee.

For an aviation publication to be fifty years old means that it has grown up with aviation from its very infancy—from Blériot's first crossing of the English Channel to the "Pioneer's" 79,000-mile flight into space, from the delivery of the first aeroplane to the U.S. Army in August, 1909, to the speed and altitude records of the U.S.A.F.'s supersonic F-104A, and from Mr. J. T. C. Moore-Brabazon's first circular flight of a mile in a British-built aeroplane to the de Havilland Comet's first scheduled jet service across the Atlantic. Jane's "All the World's Aircraft" enters its fiftieth year with a long record of service to all the World's aviation of which all who are associated with it are justifiably proud.

L.B.



Plessey

THE PLESSEY COMPANY LIMITED
ILFORD · ESSEX

Marconi in Electronics for Aviation



Over 50 Civil Airlines and 32 of the World's Air Forces rely on Marconi radio, radar or navigational aids

MARCONI *AIRPORT AND AIRCRAFT RADIO AND RADAR SYSTEMS*

MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED, CHELMSFORD, ESSEX, ENGLAND

MA2

INDEX SECTION

Aircraft - - - - -	page	iv
Rotary Wing Aircraft - - -	,,	xvii
Jet Engines - - - -	,,	xix
Piston Engines - - - -	,,	xxi

In addition to references to all items in this edition, each index contains references to every aircraft and engine described in the ten previous editions of Jane's "ALL THE WORLD'S AIRCRAFT" going back to and including 1948.

VACUMELT

VACUUM MELTED STEELS

Jessop are producing on a commercial scale steels and alloys melted in vacuum for applications in which superlative mechanical properties are specified. This ultra-modern method brings within the reach of designers and manufacturers exceptionally tough materials with an improved resistance to fatigue. Vacumelt will better withstand the severe stresses imposed by modern flying conditions and satisfy the most exacting demands of aeronautical engineers.

Hylite TITANIUM ALLOYS



HYLITE 10

HYLITE 15

HYLITE 20

HYLITE 30

HYLITE 40

HYLITE 45

HYLITE 50

The biggest titanium ingots commercially produced in Europe come from Jessop's melting plant, a notable example of the enterprise which keeps this world-famous steelmaker ahead in metallurgical developments.
Titanium alloys are produced in the form of forgings and stampings, ingots, bar, sheet, strip, wire and tube.
Seven grades are available, from commercially pure titanium to a high strength complex alloy.
"Hylite" 10 and 15 are commercially pure grades of Titanium with different hardness ranges, "Hylite" 15 having the greater tensile strength.
"Hylite" 20 contains Aluminium and Tin and has greater strength than either "Hylite" 10 or 15. It is readily weldable and does not embrittle under service conditions.
"Hylite" 30 contains Aluminium and Manganese and is a general purpose alloy.
"Hylite" 40 is a 4% Aluminium, 4% Manganese alloy suitable for stressed applications.
"Hylite" 45 is a high strength alloy containing 6% Aluminium, 4% Vanadium. It responds to heat treatment and is also weldable.
"Hylite" 50 is a complex Aluminium Alloy recommended for highest duty service. It possesses great strength combined with excellent creep resisting properties.

Jessop

WM. JESSOP & SONS LTD BRIGHTSIDE WORKS SHEFFIELD

GENERAL INDEX OF AIRCRAFT

Items printed in this type refer to this edition.
Items printed in italics refer to previous editions.

PAGE

A

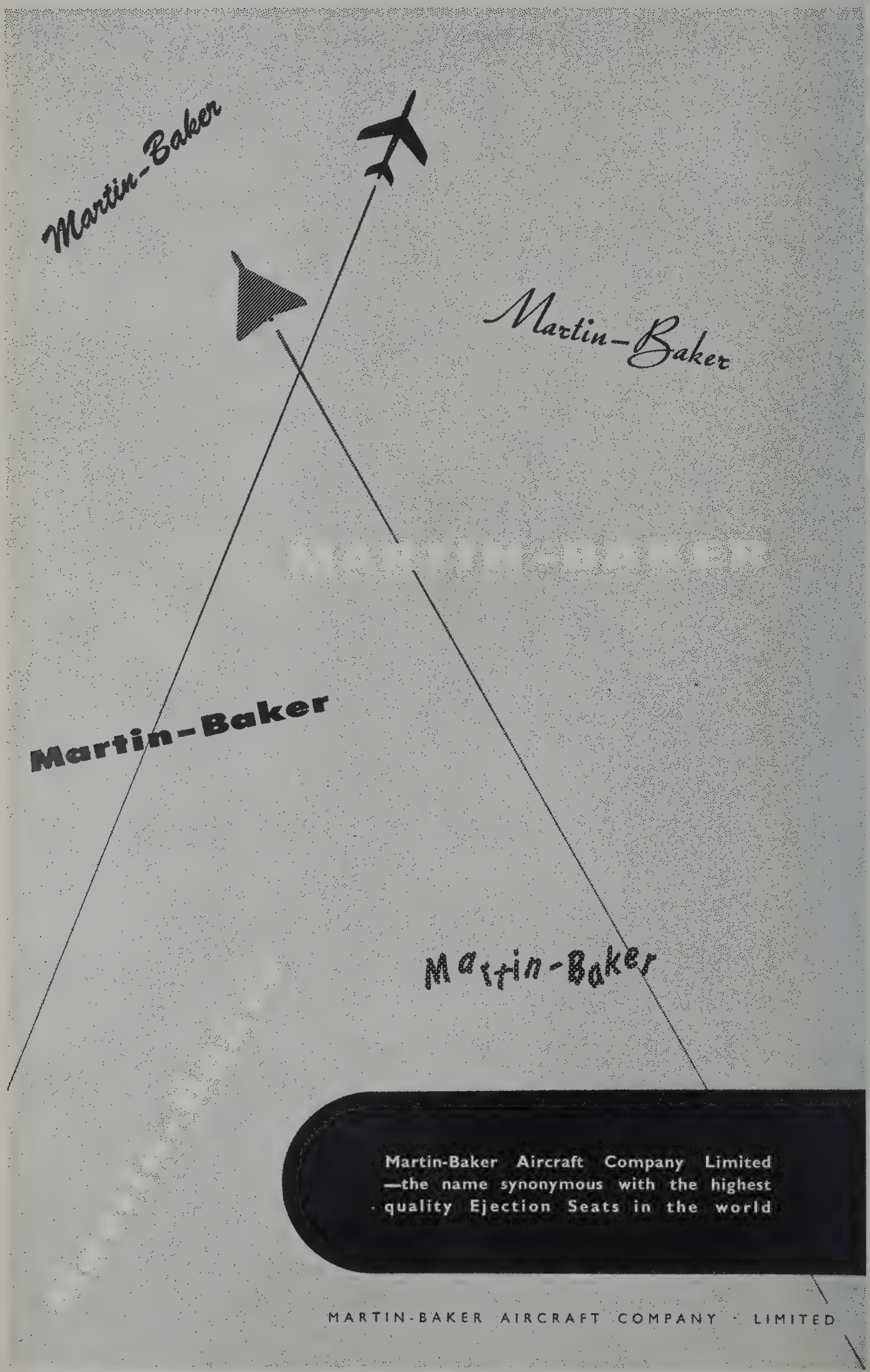
A-08 Silary (Hungary) 184
A.1 Canberra (English Electric) (1957-58) 68
A-2 (Antonov) .. .. (1950-51) 167c
A-2 (Emigh Trojan) .. (1951-52) 235c
A-2 and A-3 (Call-Air) .. (1952-53) 185
A-2 (Saab) .. .. (1955-56) 205
A2D-1 (Douglas) .. (1954-55) 240
A2F (Grumman) 306
A2U (Chance-Vought) .. (1954-55) 224
A.2/45 (Auster) .. .. (1950-51) 19c
A3D Skywarrior (Douglas) .. 294
A3J (North American) 348
A4D Skyhawk (Douglas) 293
A-4 "150" (Callair) .. (1956-57) 245
A-4 Model 150 (Callair) 271
A-4 Model 180 (Callair) 271
A-4 AG (Callair) 271
A.4/45 (Scottish Aviation) .. (1949-50) 74c
A-7 (Antonov) .. .. (1949-50) 162c
A-13 (Antonov) 218
A 21 (Saab) .. .. (1951-52) 187c
A29 (Saab) 244
A 32 (Saab) 243
A32A (Saab) .. .. (1957-58) 234
A35 Bonanza (Beechcraft) .. (1949-50) 191c
A 32A (Saab) .. .. (1955-56) 204
A.B.C. (Dassault) .. (1951-52) 123c
AC-12 (Aerotecnica) 235
ABC-A (Poland) 212
AC-13 (Aerotecnica) .. (1955-56) 197
AC-13A (Aerotecnica) 235
AC-14 (Aerotecnica) 236
ACME (see Air Craft Marine Engineering Co.) 250
AD Skyraider (Douglas) .. (1957-58) 288
AD-1 (Douglas) .. .. (1948) 253c
A.E.R.I (Aernova) .. (1949-50) 139c
AF Guardian (Grumman) .. (1955-56) 265
AFA-1 Streak 85 (Aero Flight) (1950-51) 196c
AFA-2 Streak 152 (Aero Flight) (1950-51) 196c
AFA-3 Streak 165 (Aero Flight) (1952-53) 171
Ag-Cat (Grumman) 306
Ag-1 (Texas A. & M. College) (1953-54) 277
Ag-2 (Transland) .. (1957-58) 369
Ag-3 (Texas A. & M. College) (1957-58) 368
AG-14 (Anderson, Greenwood) (1951-52) 196c
AISA (see Aeronautica Industrial S.A. 236
AJ Savage (North American) (1955-56) 298
AL 12P (S.A.I. Ambrosini) (1948) 173c
AM (Martin) .. .. (1948) 293c
AM-1 Mauler (Martin) .. (1951-52) 266c
AM.8 (Alaparma) .. (1950-51) 146c
AM.10 Tucano (Alaparma) .. (1950-51) 146c
AM.65 Balda (Alaparma) .. (1950-51) 146c
AN-2 (Antonov) 216
AN-4 (Antonov) 216
AN-8 (Antonov) 216
AN-10 (Antonov) 217
AN-14 (Antonov) 218
AN-16 (Antonov) 217
AO-1 Mohawk (Grumman) .. 307
AP.65 Baldo (Alaparma) .. (1952-53) 137
AP-75 Baldo (Alaparma) .. (1952-53) 137
ARS.5.501 (Nord) .. (1956-57) 151
A.S. 57 (Starck) .. .. (1953-54) 129
A.S. 57 (Airspeed) .. (1955-56) 46
A.S. 59 (Airspeed) .. (1951-52) 16c
A.S. 65 Consul (Airspeed) .. (1950-51) 16c
A.S. 67 (Airspeed) .. (1950-51) 16c
A.S. 70 JAC (Starck) (1948) 155c
A.S, 80 Holiday (Starck) .. (1953-54) 149
AT-6 Texan (North American) (1948) 304c
AT-21 Drone (Aviolanda) 203
ATL 90 (Aviation Traders) (1957-58) 54
ATL 91 (Aviation Traders) (1957-58) 54
AU-1 (Chance-Vought) .. (1952-53) 189
A. V. Roe & Co., Ltd. (G.B.) (1955-56) 52
A. V. Roe Canada, Ltd. .. (1955-56) 113
A.V.I.A. (see Lombardi) .. (1948) 168c
AVD-12 (AISA) 236
A.W.52 (Armstrong Whitworth) (1950-51) 18c
A.W.55 Appollo (Armstrong Whitworth) .. .. (1951-52) 17c
AW.650 (Armstrong Whitworth) .. 50
AW.651 (Armstrong Whitworth) .. 50
AW.660 (Armstrong Whitworth) .. 50
AW.661 (Armstrong Whitworth) .. 50
AW.670 (Armstrong Whitworth) .. 50
AW.671 (Armstrong Whitworth) .. 50
AZ-8L (Agusta) 188
AZ101-D (Agusta) 189

PAGE

Abeille N.C.2001 (S.N.C.A.C.) (1949-50) 113c
Accountant (Aviation Traders) (1957-58) 54
ADAM, ETABLISSEMENTS AERONAUTIQUES R. (France) (1956-57) 127
AER LUALDI & C. S.p.A. (Italy) .. 193
AERAUTO S.A. COSTRUZIONI AERONAUTICHE E MECCANICHE (Italy) .. .. (1953-54 136
AERFER-INDUSTRIE MECCANICHE AERONAUTICHE MERIDIONALI (Italy) 187
Aerial Platform (Aerophysics) .. 252
Aero-2 (Yugoslavia) 388
Aero-3 (Yugoslavia) 388
Aero 45 (Czechoslovakia) .. (1955-56) 126
Aero 54 (Czechoslovakia) .. (1950-51) 112c
Aero HC-2 Czechoslovakia) .. (1956-57) 121
Aero HC-3 (Czechoslovakia) .. 137
Aero 101 (Indraero) (1956-57) 142
Aero 110 (Indraero) .. (1956-57) 141
Aero L-200 Morava (Czechoslovakia) 136
Aerocar (Portsmouth) .. (1948) 86c
AEROCENTRE (see Centre) (1948) 133c
Aerocycle (De Lackner) .. (1957-58) 281
AERO CAPRONI TRENTO (Italy) (1954-55) 163
AERO-DIFUSIÓN S.L. (Spain) .. 235
AERO DESIGN & ENGINEERING CO. (U.S.A.) 250
AERO EVER (Hungary) .. (1951-52) 149c
AERO-FLIGHT AIRCRAFT CORPORATION (U.S.A.) (1952-53) 171
AERO FLUGZEUGBAU HUBERT ZUERL (Germany) 174
AERO KONSTRUKTORSKI BIRO (Yugoslavia) .. .. (1955-56) 301
AEROCAR, INC. (U.S.A.) .. 252
Aerocycle (De Lackner) .. (1957-58) 281
Aerojeep (Miles) .. (1957-58) 94
Aero-Jodel D.9a Bébé .. (1957-58) 172
Aero-Jodel D.112 Club .. (1957-58) 172
AERONAUTICA INDUSTRIAL S.A. (Spain) 236
AERONAUTICA MACCHI S.A. (Italy) 194
AERONCA MANUFACTURING CORPORATION (U.S.A.) (1957-58) 243
Aeronca Super Chief 11CC (1948) 213c
Aeronca 15AC Sedan .. (1948) 212c
AEROPHYSICS DEVELOPMENT CORPORATION (U.S.A.) .. 252
Aero-Plane (Aerocar) 252
Aeroscooter P-53 (Partenavia) (1957-58) 189
Aeroscooter (M.d.B.) 193
AEROTECNICA S.A. (Spain) .. 235
Aerovan (Miles) .. .. (1955-56) 91
Ag-2 (Transland) 381
Ag-3 (Texas) 380
Ag-Cat (Grumman) 306
Agricola (Auster) 53
AGUSTA, COSTRUZIONI AERONAUTICHE GIOVANNI (Italy) .. 188
Agusta-Bell Model 47 189
Aiglet Trainer (Auster) 54
Air-100 (Arsenal) .. (1950-51) 117c
Air Baby (Praga) .. (1948) 126c
AIR CRAFT MARINE ENGINEERING CO. (U.S.A.) 250
AIR-FOUGA (France) 152
Air Horse (Saunders Roe) (1951-52) 75c
Air Tractor (Lamson) .. (1957-58) 313
AIRCRAFT MANUFACTURING COMPANY (U.S.A.) .. (1951-52) 292c
AIRCRAFT MANUFACTURING CO. LTD. (G.B.) 50
Airco (see Aircraft Manufacturing Co. Ltd.) 50
Aircoupe (Forney) 304
Airone (Pasotti) .. .. (1957-58) 190
Airphibian FA-2 (Fulton) .. (1953-54) 209
AIRSPEED DIVISION OF THE DE HAVILLAND AIRCRAFT CO., LTD. .. .. (1955-56) 46
ALAPARMA S.p.a. (Italy) (1952-53) 137
Albatross (Grumman) 311
Alcotan 201 (CASA) 288
Alcyon (M-S) .. .. (1955-56) 149
Alize (Breguet) 144
Allievo Cantu (Ambrosini) .. (1950-51) 148c
ALI VIBERTI S.p.a. (Italy) (1951-52) 162c
Alouette (Sud-Est) .. (1953-54) 151
Alouette II (Sud) 171
Alpha (Auster) 54

PAGE

Alpine (Auster) 54
Alti-Cruiser (Aero) 251
Ambassador (Airspeed) .. (1955-56) 46
AMBROSINI (See Societa Aeronautica Italiana, Ing. A. Ambrosini & C.) 189
American Eaglet (American Eaglecraft) (1948) 215c
AMERICAN HELICOPTER COMPANY, INC. (U.S.A.) .. (1954-55) 206
AMERICAN HELICOPTER DIV., FAIRCHILD ENGINE and AIRPLANE CORP. (U.S.A.) (1955-56) 214
Amphibian (Yugoslavia) 389
ANDERSON, GREENWOOD & COMPANY U.S.A.) .. (1953-54) 197
ANGKATAN UDARA REPUBLIK INDONESIA, DEPOT PENJELIDIKAN, PERTJOBAAN DAN PEMBUATAN (Indonesia) .. 185
Anjou (Boisavia) 143
Anser (ACME) 250
Anson (Avro) .. .. (1952-53) 40
ANTONOV, OLEG K. (Soviet Union) 216
Apache (Piper) 360
Apollo (Armstrong Whitworth) (1951-52) 17c
Aqua I (Aquaflight) .. (1949-50) 189c
Aquilon (Sud) 169
Arbaléte (Payen) 164
Argus (Canadair) 124
Ariel II (Sud-Ouest) .. (1951-52) 148c
Ariel III (Sud-Ouest) .. (1954-55) 157
Aries M.75 (Miles) .. (1955-56) 91
Ariete (Aerfer) 187
Aristocraft (Waco) .. (1948) 324c
Armagnac (Sud-Est) .. (1953-54) 151
ARMSTRONG WHITWORTH AIRCRAFT LTD. Sir W. G. (G.B.) .. 50
Army Mule (Vertol) 382
Arrow (Auster) .. .. (1951-52) 21c
Arrow (Avro Canada) 121
Ars 1301 (S.F.E.C.M.A.S.) (1953-54) 147
Ars 5.501 (S.F.E.C.M.A.S.) (see Nord CT.10) .. .. (1955-56) 154
Arsenal 2301 .. .. (1952-53) 109
Arsenal 4111 .. .. (1950-51) 117c
Arsenal 5.501 .. .. (1953-54) 110
ARSENAL DE L'AERONAUTIQUE (France) (see Nord) .. (1955-56) 154
Ashton (Avro) .. .. (1952-53) 39
Asiago 2 (Ambrosini) .. (1950-51) 148c
Atar (Sud-Ouest) .. (1954-55) 155
Atar Volant (SNECMA) 166
ATELIERS AERONAUTIQUES DE LA COTE D'EMERAUDE (France) 165
Athena (Avro) .. .. (1951-52) 22c
Atlantic (Avro) .. .. (1953-54) 49
Atlantic (Auster) 53
Attacker (Supermarine) .. (1954-55) 99
AUBERT, PAUL (France) .. 142
Aula Volante (Fiat) .. (1951-52) 152c
AUSTER AIRCRAFT, LTD. (G.B.) .. 52
Auster Avis .. .. (1948) 24c
Auster A.O.P. Mk. 6 .. (1956-57) 46
Auster T. Mk. 7 .. (1956-57) 46
Auster A.O.P. Mk. 9 .. (1956-57) 46
Auster B.4 .. .. (1955-56) 50
Auster J.5 .. .. (1955-56) 50
Autocar (Auster) 55
Autocrat J/1 (Auster) .. (1955-56) 50
A. V. ROE & CO., LTD. (G.B) (1957-58) 55
A. V. ROE CANADA, LTD. (Canada) (1957-58) 113
Avenger (Grumman) .. (1951-52) 246c
Avia 14 (Czechoslovakia) 136
Avia L-60 (Czechoslovakia) .. (1956-57) 121
Avia LD-40 (Czechoslovakia) (1956-57) 121
AVIAMILANO COSTRUZIONI AERONAUTICHE (Italy) .. 189
Aviastar (Lombardi) .. (1949-50) 147c
AVIATION TRADERS (ENGINEERING) LTD. (G.B.) .. (1957-58) 54
AVIOES MIGNET DO BRASIL (1953-54) 43
AVIOLANDA MAATSCHAPPIJ VOOR VLIEGTUIGBOUW N.V. (Netherlands) 203
AVIONS FAIREY S.A. (Belgium) .. 46
Avis 2 (Auster) .. .. (1951-52) 22c
Avitruc Chase) .. .. 1953-54) 213
AVRO (see A. V. Roe & Co. Ltd.) (1957-58) 55
AVRO AIRCRAFT LTD. (Canada) .. 121
Avro Atlantic .. .. (1953-54) 49
Avro Flying Test Beds .. (1951-52) 26c
Avro 652A Anson .. (1952-53) 40


Martin-Baker
Martin-Baker
Martin-Baker
Martin-Baker
Martin-Baker Aircraft Company Limited
—the name synonymous with the highest
quality Ejection Seats in the world
MARTIN-BAKER AIRCRAFT COMPANY LIMITED

PAGE

Avro 694 Lincoln .. *(1951-52)* 25c
Avro 696 Shackleton .. *(1956-57)* 50
Avro 698 Vulcan .. *(1956-57)* 50
Avro 701 (Athena) .. *(1951-52)* 22c
Avro 706 Ashton .. *(1952-53)* 39
Avro 707 .. .. *(1955-56)* 52
Avro C.102 .. .. *(1950-51)* 100c
Avro C.F.100 .. .. *(1955-56)* 113
Avro Tudor .. .. *(1950-51)* 25c
Azor (CASA) 239

B

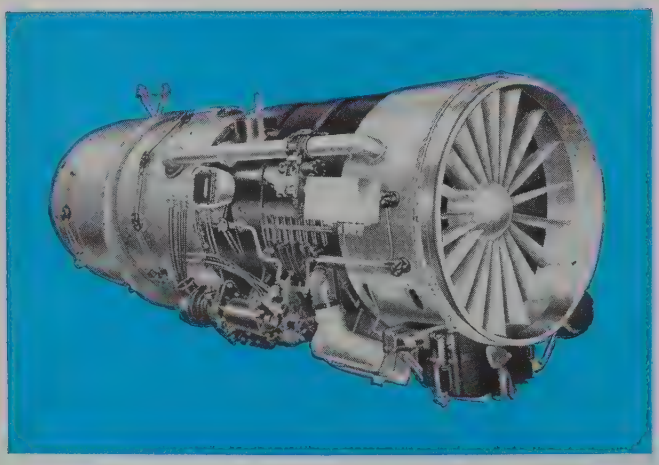
B-2 (Brantly) 271
B-3 (Brantly) 271
B-2 Monitor (Neiva) 48
B.4 (Auster) .. .. *(1955-56)* 50
B-7 Gyro-Glider (Benson) 262
B-7B Gyro-Boat (Benson) .. 262
B-7M Gyro-Copter (Benson) .. 263
B-7W Hydro-Glider (Benson) .. 262
B.8 Agricola (Auster) 53
B-8M Gyro-Copter (Bensen) .. 263
B-8W Hydro-Glider (Bensen) .. 262
B-11C Little Pink Cloud (Billman) .. 263
B-11 (Billman) .. .. *(1957-58)* 253
B-12 (Yugoslavia) 387
B.18 (Saab) .. .. *(1951-52)* 187c
B.20 (Boeing) .. .. *(1949-50)* 199c
B.29 (Boeing) .. .. *(1951-52)* 208c
B.35 (Northrop) .. .. *(1949-50)* 264c
B.35 Bonanza (Beechcraft) .. *(1950-51)* 199c
B.36 (Convair) .. .. *(1957-58)* 276
B.36A (Convair) .. .. *(1948)* 239c
B.45 Firebrand (Blackburn) *(1949-50)* 29c
B-45 Mentor (Beechcraft) .. *(1955-56)* 216
B-45 Mentor (Fuji) .. *(1956-57)* 182
B.45 Tornado (North American) *(1951-52)* 273c
B.46 Firebrand (Blackburn) *(1951-52)* 27c
B-47 Stratojet (Boeing) 268
B.48 (Blackburn) .. *(1950-51)* 30c
B.50 (Boeing) .. .. *(1953-54)* 209
B.52 Stratofortress (Boeing) .. 267
B.56 (Boeing) .. *(1950-51)* 204c
B-57 Canberra (Martin) 341
B-58 Hustler (Convair) 283
B-60 Mercurey (Boisavia) 142
B-61 Matador (Martin) (see TM-61) *(1955-56)* 292
B-66 Destroyer (Douglas) 295
B-70 (North American) 348
B-85-C (Funk) Bee .. *(1952-53)* 210
B.250 Brigadier (Baumann) *(1949-50)* 190c
B-260 Anjou (Boisavia) 143
B.290 Brigadier (Baumann) *(1955-56)* 214
B.320 (Macchi) .. .. *(1950-51)* 156c
B-360 De Luxe Brigadier (Baumann) .. 253
B-480 Super Brigadier (Baumann) .. 253
B-603 (Boisavia) .. *(1954-55)* 130
B-604 (Boisavia) .. *(1954-55)* 130
B-605 (Boisavia) .. *(1954-55* 130
Bax-3 and 4 (Bunyard) .. *(1948)* 231c
BC 12D-65 Traveler (Taylorcraft) *(1951-52)* 291c
BC 12D-85 Sportsman (Taylorcraft) *(1951-52)* 291c
BE-6 (Beriev) 219
BE-8 (Beriev) 219
BICH (Cheranovskii) .. *(1950-51)* 167c
Bl.500 (Blume) 174
Bl-502 (Blume) 377
BLC-Pantobase (Stroukoff) .. 377
BN-1 (Neiva) 48
B.P. 471 (Breda) .. *(1951-52)* 154c
BS-12 Twin (Omega) 358
B-2 Monitor (Neiva) 48
BZ-4 Zuk (Poland) 211
B.Z. 308 (Breda) .. *(1951-52)* 153c
B.Z. 309 (Breda) .. *(1951-52)* 154c
Baade Type 152 (East Germany) .. 181
Baby 11B (East Germany) .. 183
Baby (Larson) 321
Baby-Albatross (Laister-Kauffmann) *(1948)* 275c
Baby Eon (Elliotts) .. *(1950-51)* 55c
BACON CORPORATION, ERLE L. (U.S.A.) 253
Badger (Beechcraft) .. *(1956-57)* 229
Badger (Tupolev) 230
Bak. 11 (Poland) .. *(1951-52)* 168c
Balang (Philippine) .. *(1955-56)* 185
Baldo (Aleparma) .. .. *(1952-53)* 137
Balliol (Boulton Paul) .. *(1955-56)* 57
Banshee (McDonnell) .. *(1955-56)* 285
Bantam X-4 (Northrop) .. *(1951-52)* 276c
Barge (Tupolev) .. .. *(1955-56)* 193
Baroudeur (Sud) .. *(1957-58)* 167
Barougan (Dassault) .. *(1957-58)* 147
BAUMANN AIRCRAFT CORPORATION (U.S.A.) 253
Beagle (Ilyushin) 219
Bear (Tupolev) 230
Bearcat G-58 (Grumman) .. *(1949-50)* 299c
BÉARN, CONSTRUCTIONS AERONAUTIQUES DU (France) *(1956-57)* 136
Beast (Ilyushin) .. .. *(1955-56)* 191
Beaufighter (Bristol) .. *(1950-51)* 39c
Beaver (D.H. Canada) 128
Beaver Amphibion (D.H. Canada) .. 129
Bebe (Aero-Jodel) 174
Bébé (Jodel) 156
BEE AVIATION ASSOCIATES INC. (U.S.A.) .. .. *(1955-56)* 215
BEECH AIRCRAFT CORPORATION (U.S.A.) 254
BEECHCRAFT (see Beech Aircraft Corporation) 254
Beke (Hungary) 184
Belalang (Indonesia) 185
Belfair (Avions Fairey) .. *(1949-50)* 9c
BELL AIRCRAFT CORPORATION (U.S.A.) 258
BELL HELICOPTER CORPORATION (U.S.A.) 259
BELLANCA AIRCRAFT CORPORATION (U.S.A.) .. *(1956-57)* 236
Bellairus (Bell) 261
Bellatrix (Sud-Ouest) .. *(1948)* 162c
Belphégor (S.N.C.A.C.) .. *(1949-50)* 113c
BENSEN AIRCRAFT CORP (U.S.A.) 262
Bergfalke II/55 (Scheibe) 180
BERIEV, G.M. (Soviet Union) .. 218
Beverly (Blackburn) 59
Bich-22 (Cheranovski) .. *(1949-50)* 162c
Bichao (I.P.T.) .. .. *(1951-52)* 13c
Bichinho (I.P.T.) .. *(1951-52)* 12c
Bies (Poland) 210
BILLMAN AVIATION COMPANY (U.S.A.) 263
Bipassaro (Movo) .. *(1949-50)* 149c
Bird Dog (Cessna) 273
Bison (Ilyushin) .. .. *(1957-58)* 212
Bison (Myasishchev) 226
BLACKBURN & GENERAL AIRCRAFT LTD. (G.B.) 59
Blanik (Czechoslovakia) 137
Blowlamp (Soviet Union) .. *(1957-58)* 224
BLUME, INGENIEUR-BURO (Germany) 174
Bocian (Poland) .. .. *(1957-58)* 207
BOEING AIRPLANE COMPANY (U.S.A.) 264
Boenisch-Vogel (East Germany) .. 183
BOISAVIA, SOCIETE (France) .. 142
Bomarc (Boeing) 270
Bonanza (Beechcraft) 254
Bonzo M.3 (Czechoslovakia) *(1951-52)* 111c
BORGWARD, CARL F. W. G.m.b.H. (Germany) 174
Bosun (Tupolev) 230
Botond (Hungary) .. *(1956-57)* 168
BOULTON PAUL AIRCRAFT LTD. (G.B.) 61
Brabazon (Bristol) .. *(1952-53)* 45
BRANTLY HELICOPTER CORPORATION (U.S.A.) 271
BRATUKHIN, PROFESSOR IVAN P. (Russia) .. .. *(1951-52)* 170c
BREDA SOCIETA ITALIANA ERNESTO (Italy) .. *(1951-52)* 153c
BREGUET, SOCIÉTÉ ANONYME DES AVIONS LOUIS (France) .. 143
Breguet 482 .. .. *(1948)* 139c
Breguet 761 .. .. *(1948)* 138c
Breguet 890J .. .. *(1948)* 139c
Breguet 892S .. .. *(1948)* 140c
Bretagne (Sud-Ouest) .. *(1955-56)* 160
Brigadier (Baumann) 253
Brigadyr (Czechoslovakia) 134
Brigand (Bristol) .. .. *(1951-52)* 36c
BRISTOL AEROPLANE CO., LTD. (G.B.) 61
BRISTOL AEROPLANE COMPANY OF CANADA (1956) LTD. (Canada) 123
BRISTOL AIRCRAFT LTD. (G.B.) .. 61
BRISTOL AIRCRAFT (WESTERN) LTD. (Canada) 123
Bristol 170 .. .. *(1955-56)* 60
Bristol 171 .. .. *(1955-56)* 62
Bristol 173 .. .. *(1955-56)* 61
Bristol 175 .. .. *(1957-58)* 54
Britannia (Bristol) 62
BROCHET, AVIONS MAURICE (France) 147
Broussard (Holste) 158
Buck Private (American Helicopter) *(1951-52)* 196c
Buckaroo (Temco) .. *(1953-54)* 277
Bull (Tupolev) .. .. *(1955-56)* 193
Bullet 205 (Texas) .. *(1951-52)* 292c
BURGFALKE FLUGZEUGBAU (Germany) 175
Bushmaster (Hayden) 312
Butcher (Ilyushin) .. *(1955-56)* 189

C

C-1 Hoppi-copter (Capital) .. *(1955-56)* 229
C-1 Skimmer (Colonial) 280
C-2 Skimmer IV (Colonial) .. 280
C-3 Trojka (Yugoslavia) 389
C-4 (Canadair) .. .. *(1948)* 115c
C-5 (Hönningstad) .. .. *(1948)* 178c
C-5 Polar (Widerõe) .. .. *(1951-52)* 162c
C-11 (Czechoslovakia) 133
C-11U (Czechoslovakia) 133
C.35 Bonanza (Beechcraft) .. *(1952-53)* 175
C-45 (Beechcraft) .. *(1955-56)* 217
C-46R (Riddle) 366
C.47 Skytrain (Douglas) .. *(1951-52)* 234c
C-50 (Beechcraft) .. *(1955-56)* 216
C.54 Skymaster (Douglas) .. *(1956-57)* 277
C-54-GM (Canadair) .. *(1948)* 115c
C.74 (Douglas) .. .. *(1951-52)* 226c
C-82 Packet (Fairchild) .. *(1957-58)* 294
C-97 Stratofreighter (Boeing) .. 270
C-97B Stratocruiser (Boeing) *(1949-50)* 197c
C-102 (Avro Canada) .. *(1952-53)* 95
C-118 (Douglas) 300
C-118A (Douglas) .. *(1955-56)* 256
C-119 Packet (Fairchild) .. *(1957-58)* 294
C-121 Constellation (Lockheed) .. 327
C-123 (Chase) .. .. *(1953-54)* 213
C-123B Provider (Fairchild) .. 302
C-124 (Douglas) 292
C-125 Raider (Northrop) .. *(1951-52)* 277c
C-130 (Lockheed) 324
C-131 (Convair) 288
C-133 (Douglas) 291
C.400 Atar (SNECMA) 166
C-450 Coleoptere (SNECMA) .. 166
C.449 (Nord) .. .. *(1948)* 150c
C.800 (Nord) .. .. *(1948)* 151c
C.3603 (Swiss Federal Aircraft Factory) *(1948)* 205c
C.3604 (Fédérale) .. *(1951-52)* 189c
CA.15 (Commonwealth) .. *(1948)* 111c
CA-22 (Commonwealth) .. *(1954-55)* 112
CA-25 Winjeel (Commonwealth) .. 118
CA-27 Sabre (Commonwealth) .. 117
CA-28 (Commonwealth) 117
Ca. 191 (Caproni) .. *(1948)* 165c
Ca-193 (Caproni) .. *(1950-51)* 150c
C.A.B. (see Constructions Aéronautiques du Béarn) .. *(1957-58)* 144
C.A.P.1 (Companhia Aeronautica Paulista) .. .. *(1948)* 14c
C.A.P.4 (Companhia Aeronautica Paulista) .. .. *(1948)* 13c
C.A.P.4B Ambulancia .. *(1948)* 14c
C.A.P.4C Paulistinha Radio *(1948)* 14c
C.A.P.5 (Companhia Aeronautica Paulista) .. .. *(1948)* 13c
CASA (see Construcciones Aeronauticas S.A.) 238
CASA-201 Alcotan (CASA) 238
CASA-202 Halcon (CASA) 238
CASA-207 Azor (CASA) 239
CC-106 (Canadair) 123
CC-109 (Canadair) 123
CC-108 (de Havilland) 126
C.C.F. see Canadian Car & Foundry Co., Ltd.) .. .. *(1955-56)* 114
CCW-5 (Custer) .. .. *(1956-57)* 263
CF-100 (Avro Canada) 122
CF-105 Arrow (Avro Canada) .. 121
C.F.A (see Compagnie Francaise d'Aviation) .. .. *(1953-54)* 130
CH-1 (Cessna) .. .. *(1957-58)* 266
CH-1B (Cessna) 276
C.H.3 Series 2 and 3 Super Ace (Chrislea) *(1951-52)* 37c
C.H.3 Series 4 Skyjeep (Chrislea) *(1951-52)* 37c
CL-28 Argus (Canadair) 124
CL-41 (Canadair) 124
CL-44 (Canadair) .. *(1957-58)* 121
CL-44D (Canadair) 123
CL-66 (Canadair) 123
CL-106 (Canadair) .. *(1957-58)* 121
CL-107 (Canadair) .. *(1957-58)* 121
CL-329 (Lockheed) .. *(1957-58)* 315
CM 7 (Fouga) .. .. *(1951-52)* 125c
C.M. 8-R 9.8 Cyclone 1 (Fouga) *(1951-52)* 126c
C.M. 8-13 and 8-15 (Fouga) *(1951-52)* 125c
C.M.7 (Fouga) .. .. *(1951-52)* 125c
C.M. 8-13 (Fouga) .. *(1951-52)* 125c
C.M. 8-15 (Fouga) .. *(1951-52)* 125c
C.M.8.R-8.3 Midjet (Fouga) *(1953-54)* 135
C.M.8.R-9.8 Cyclope (Fouga) *(1953-54)* 136



FOX ALLOY STEELS



The Rolls-Royce Conway (left) and the Rolls Royce Dart (above left) gas turbine aero engines make use of the unique properties of Fox Foxtiweld and Jethete steels.

SAMUEL FOX & COMPANY LIMITED STOCKSBRIDGE WORKS · SHEFFIELD · ENGLAND

F446

A subsidiary company of The United Steel Companies Limited

THE UNITED STEEL COMPANIES LTD

PAGE

C.M.S.R-13 Sylphe III (Fouga) (1954-55) 139
C.M. 10 (Fouga) .. (1949-50) 120c
C.M. 71 (Fouga) .. (1954-55) 130
C.M. 88-R Gemeaux (Fouga) (1953-54) 136
C.M. 100 and 101 (Fouga) .. (1949-50) 119c
C.M. 101-R (Fouga) .. (1952-53) 116
C.M. 160 (Fouga) .. (1956-57) 140
C.M. 170M (Fouga) .. (1956-57) 140
C.M. 170-R Magister (Fouga) .. 152
C.M. 171 Makalu (Fouga) (1957-58) 151
C.M. 175 Esquif (Fouga) 154
C.M. 191 (Fouga) .. (1956-57) 140
C.M. 195 (Fouga) .. (1956-57) 140
C.M.A. (see Construzioni Meccaniche Aeronautiche S.P.A.) .. (1948) 165c
C.M. Jalon (Castel-Mauboussin) (1948) 143c
C.P. 30 (Piel) .. .. (1957-58) 162
CP-107 (Canadair) 124
CP-110 (Agusta) .. .. (1952-53) 136
CS2F (Grumman-D.H. Canada) (1957-58) 122
CS-102 (Czechoslovakia) 133
C.S.S. 10 (Poland) .. (1953-54) 173
C.S.S. 11 (Poland) .. (1953-54) 174
C.S.S. 12 (Poland) .. (1956-57) 193
C.S.S. 13 (Poland) .. (1956-57) 194
CT.10 (Nord) 163
CT.20 (Nord) 163
CV-130 Comet (Hockaday) .. (1948) 270c
C.V.V. (see Instituto di Aeronautica Politecnico de Milano) .. (1951-52) 154c
C.V.V.2 (S.A.I. Ambrosini) (1948) 173c
C.V.V.6 (S.A.I. Ambrosini) (1948) 173c
CW-32 (Curtiss) .. .. (1948) 244c
Caboré (I.P.T.) .. .. (1951-52) 14c
CALL AIRCRAFT COMPANY (U.S.A.) 271
Call-Air (see Call Aircraft Company) (1957-58) 262
Call-Air Cadet .. .. (1951-52) 211c
Calquin (Instituto Aerotecnico) (1951-52) 9c
CAMAIR DIVISION OF CAMERON IRON WORKS, INC. (U.S.A.) (1956-57) 246
Camair 480 246
Camel (Tupolev) 229
Camp (Antonov) 216
CANADAIR, LTD. (Canada) (1957-58) 120
Canadair Four .. .. (1955-56) 116
Canadair Five .. .. (1955-56) 117
Canadair 540 (Canadair) 123
CANADIAN CAR CO. LTD. (Canada) .. 123
Canberra (English Electric) .. 75
Canberra (Martin) .. (1953-54) 253
CAN-CAR (see Canadian Car Co. Ltd.) (1957-58) 122
CANCARGO AIRCRAFT MANUFACTURING CO., LTD. (Canada) (1952-53) 99
Canguru (Ambrosini) .. (1950-51) 148c
CANTINIEAU, JEAN (France) .. .. (1953-54) 142
Canuck (Avro, Canada) .. (1951-52) 99c
CAPITAL HELICOPTER CORP. (U.S.) .. .. (1955-56) 229
CAPRONI (see Aero Caproni Trento) (1954-55) 163
Caravan (Miles) 96
Caravelle (Sud) 167
Caribou (D.H. Canada) 126
Cargomaster (Douglas) 291
Carioca (Companhia Aeronautica Paulista) .. .. (1948) 13c
CARMA MANUFACTURING COMPANY (U.S.A.) 272
Casmuniz 52 (Muniz) 49
Castel-Mauboussin (see Fouga) (1948) 143c
Cat (Antenov) 217
Cauré (C.N.N.A.) .. (1949-50) 11c
Centauvaus (Oakland Airmotive) .. 357
Centaurus-Fury (Hawker) .. (1948) 72c
CENTRAL-LAMSON CORP. (U.S.) (1955-56) 220
CENTRAL WORKSHOPS (Chile) (1956-57) 120
CENTRE EST AERONAUTIQUE (France) 148
Centurion (Miles) .. (1957-58) 92
Ceres (Commonwealth) 117
CESKOSLOVENSKE ZAVODY LETECKE (Czechoslovakia) .. 133
CESSNA AIRCRAFT CO., INC. (U.S.A.) 272
Cessna 170 .. .. (1956-57) 248
Cessna 172 .. .. (1957-58) 265
Cessna 180 .. .. (1957-58) 266
Cessna 182 .. .. (1957-58) 266
Cessna 190 .. .. (1953-54) 212
Cessna 195 222
Cessna 305 .. .. (1955-56) 231
Cessna 308 .. .. (1953-54) 210
Cessna 310 .. .. (1957-58) 265
Cessna 318 .. .. (1957-58) 263

PAGE

Cessna 321 .. .. (1957-58) 265
Cessna 620 .. .. (1957-58) 263
Champion (Aeronca) .. (1952-53) 172
Champion 7EC .. .. (1956-57) 250
CHAMPION AIRCRAFT CORP. (U.S.A.) 277
CHANCE VOUGHT AIRCRAFT INC. (U.S.A.) 277
Chardonneret (Aérocentre) .. (1948) 134c
CHASE AIRCRAFT COMPANY INC. (U.S.A.) .. (1954-55) 225
Chickasaw (Sikorsky) 374
CHILTON AIRCRAFT CO., LTD. (G.B.) .. .. (1952-53) 49
Chincol (Fanaero) 132
Chipmunk Mk. 23 (D.H.) 72
Chipmunk (D.H. Canada) .. (1955-56) 121
Chipmunk T.10 (D.H.) .. (1956-57) 66
Choctaw (Sikorsky) 371
Choucas (Breguet) 147
CHRISLEA AIRCRAFT CO., LTD. (G.B.) .. .. (1951-52) 37c
CIERVA (see Saunders-Roe) (1951-52) 73c
Cigale Major (Aubert) .. (1956-57) 127
Cigogne (Aubert) 142
Cijan C-3 Trojka (Yugoslavia) (1951-52) 293c
CLARK AIRCRAFT, INC. (U.S.A.) .. 280
Cleat (Tupolev) 228
Clen Antu (Instituto Aerotecnico) (1956-57) 39
Clipper PA-16 (Piper) .. (1949-50) 269c
Cloudster (Douglas) .. (1948) 254c
Club (Aérocentre) .. (1948) 134c
Club (Aero-Jodel) 174
Club (Jodel) 156
Club-Air (Ercoupe) .. (1951-52) 236c
Coach (Ilyushin) 221
Coccinelle (SIPA) .. (1957-58) 163
Coléoptère (SNECMA) 166
Colibri (Instituto Aerotecnico) (1951-52) 9c
Colmar (Breguet) .. (1953-54) 119
COLONIAL AIRCRAFT CORPORATION (U.S.A.) 280
Colt (Antonov) 216
Comanche (Piper) 360
Comet (D.H.) 70
Comet (Hockaday) .. (1948) 270c
Commander 500 (Aero) 250
Commander 520 (Aero) .. (1952-53) 171
Commander 560 (Aero) .. (1957-58) 241
Commander 560E (Aero) 250
Commander 680 Super (Aero) .. 251
Commander 720 Alti-Cruiser (Aero) .. 251
COMMONWEALTH AIRCRAFT CORPORATION PTY., LTD. (Australia) 117
COMPAGNIE FRANCAISE D'AVIATION (France) .. (1953-54) 130
COMPAGNIA GENERALE E LETTRODOMESTICI (Aircraft Division) (Italy) 192
COMPANHIA NACIONAL DE NAVEGACAO AEREA (Brazil) (1951-52) 12c
Concordia (Cunliffe-Owen) .. (1948) 46c
Condor (Druine) 152
CONSOLIDATED VULTEE AIRCRAFT CORPORATION (U.S.A.) (see Convair) .. .. (1955-56) 236
Constellation (Lockheed) 327
Constitution (Lockheed) .. (1950-51) 245c
CONSTRUCCIONES AERONAUTICAS S.A. (Spain) 238
CONSTRUCTIONS AERONAUTIQUE DU BEARN (France) 147
CONSTRUCTIONS AERONAUTIQUES STAMPE ET RENARD S.A. (Belgium) .. (1957-58) 45
CONSTRUZIONI AERONAUTICHE GIOVANNI AGUSTA (Italy) .. 188
Consul (Airspeed) .. (1950-51) 16c
CONTINENTAL, INC. (U.S.A.) (1952-53) 209
CONVAIR DIVISION OF GENERAL DYNAMICS CORPORATION (U.S.) 280
Convair 440 285
Convair 880 284
Convair-Liner 240 287
Convair-Liner 340 287
Convertiplane (Bell) .. (1955-56) 219
Convertiplane (Jacobs) .. (1955-56) 280
Convertiplane (McDonnell) .. (1955-56) 286
Cooker (Tupolev) 229
Coot (Ilyushin) 220
Cork (Yakovlev) .. (1956-57) 207
Cormoran N.C. 211 (Aérocentre) (1949-50) 110c
Corsair F4U (Chance Vought) (1952-53) 188
Corse II (Sud-Ouest) .. (1951-52) 146c
Cougar (Grumman) 308
Courier (Helio) 314
Courlis (S.E.C.A.N.) .. (1951-52) 139c
Crate (Ilyushin) 220
Creek (Yakovlev) 233

PAGE

Cri-Cri Major (C.F.A.) .. (1950-51) 122c
Cropmaster (Kingsford Smith) .. 120
Crow (Yakovlev) .. .. (1956-57) 207
Cruisair (Bellanca) .. (1952-53) 180
Cruisemaster (Bellanca) .. (1952-53) 179
Cruisemaster 14-19-2 (Northern) .. 355
Crusader III (Chance Vought) .. 279
Cub Special (Piper) .. (1948) 310c
CURTISS AIRPLANE DIVISION CURTISS-WRIGHT CORPORATION (U.S.A.) .. (1951-52) 222c
CUSTER CHANNEL WING CORPORATION (U.S.A.) .. (1956-57) 263
Cutlass F7U (Chance Vought) (1957-58) 270
Cyclope 1 (Fouga) .. (1951-52) 126c
Cyclope III (Fouga) .. (1953-54) 136
Czajka (Poland) 213
Czapla (Poland) 213
CZECHOSLOVAK AIRCRAFT WORKS .. .. (1957-58) 129

D

D-1 (Larson) 321
D.5 Turbi (Druine) 151
D-7 Cri-Cri Major (C.F.A.) (1950-51) 122c
D.9 Bébé (Jodel) 156
D.9a (Aero-Jodel) 174
D.10 (Jodel) .. .. (1950-51) 127c
D.11 (Jodel) 174
D18C (Beechcraft) .. (1948) 219c
D.18S (Beechcraft) .. (1955-56) 217
D.31 Turbulent (Druine) 151
D35 (Beechcraft) .. .. (1953-54) 199
D50A Twin-Bonanza (Beechcraft) .. 256
D.60 Condor (Druine) .. (1955-56) 141
D.111 (Jodel) 156
D.112 (Aero-Jodel) .. (1957-58) 172
D.112 Club (Jodel) 156
D-177 Grand Tourisme (Jodel) .. 164
D.120 Paris-Nice (Wassmer) .. 173
D-140 (Normande Jodel) 164
D-558-I Skystreak (Douglas) (1954-55) 236
D-558-II Skyrocket (Douglas) (1954-55) 236
D.3803 (Flug and Fahrzeugwerke) (1950-51) 190c
DHC-2 Beaver (D.H. Canada) .. 128
DHC-3 Otter (D.H. Canada) .. 128
DC-3 (Douglas) .. .. (1952-53) 205
DC-4 (Douglas) .. .. (1951-52) 232c
DC-4M-1 and 2 (Canadair) (1948) 115c
DC-6 (Douglas) 299
DC-6A (Douglas) 300
DC-6B (Douglas) 299
DC-6C (Douglas) .. .. (1957-58) 293
DC-7 (Douglas) 297
DC-7B (Douglas) 298
DC-7C (Douglas) 298
DC-8 (Douglas) 296
DFS 8-346 (Russia) .. (1954-55) 188
D.H. (see de Havilland Aircraft Co. Ltd.) 65
DH-4 (De Lackner) .. (1957-58) 281
DH-5 Aerocycle (De Lackner) .. 289
DH-28 (De Temple) 290
D.H. 98 Mosquito (de Havilland) (1950-51) 52c
D.H. 100 Vampire (de Havilland) (1954-55) 65
D.H. 100 Sea Vampire (de Havilland) (1954-55) 65
D.H. 103 (de Havilland) .. (1951-52) 45c
D.H. 104 Devon (de Havilland) .. 71
D.H. 104 Dove (de Havilland (1957-58) 70
D.H. 106 Comet (de Havilland) .. 70
D.H. 108 (de Havilland) .. (1949-50) 43c
D.H. 110 (de Havilland) 68
D.H. 112 Venom (de Havilland) .. 68
D.H. 113 Vampire Night Fighter (de Havilland) .. .. (1954-55) 66
D.H. 114 Heron (de Havilland) .. 67
D.H. 115 Vampire Trainer (de Havilland) 66
D.H. 121 (de Havilland) 66
DHA-3 Drover (D.H. Australia) (1953-54) 109
DHC-1 Chipmunk T. Mk. 10 (D.H.) (1956-57) 66
D.H.C.1 Chipmunk Mk. 23 (D.H.) .. 72
DHC-1 (Chipmunk D.H. Canada) (1955-56) 121
DHC-2 Beaver (D.H. Canada) .. 129
DHC-3 Otter (D.H. Canada) .. 127
DHC-4 Caribou (D.H. Canada) .. 126
D.L. 22 (Instituto Aerotecnico) (1951-52) 9c
D.L. 22-C (Instituto Aerotecnico) (1951-52) 10c
DM-6R (Yugoslavia) 387
Do 25 (Dornier) .. (1956-57) 201
Do 27 (Dornier) 176

PAGE

DR.100 (Centre Est) 148
Dakota (Douglas) .. .. *(1951-52)* 234c
Dart Herald (Handley Page) .. 85
Daru (Hungary) .. *(1956-57)* 168
DASSAULT, GÉNÉRALE AÉRONAUTIQUE MARCEL (France) .. 148
Dauphine (Legrand-Simon) .. 157
DE HAVILLAND AIRCRAFT CO., THE (G.B.) 65
DE HAVILLAND AIRCRAFT CO., OF NEW ZEALAND (N.Z.) *(1954-55)* 113
DE HAVILLAND AIRCRAFT OF CANADA LTD., THE (Canada) .. 126
DE HAVILLAND AIRCRAFT CO., (Pty.), LTD. (Australia) .. 118
DE HAVILLAND HOLDINGS, LTD. (G.B.) 65
DE SCHELDE, N.V. KONINKLIJKE MAATSCAPPIJ (Netherlands) *(1953-54)* 169
DE LACKNER HELICOPTERS, INC. (U.S.A.) 289
De Luxe Brigadier (Baumann) .. 253
Deauville (Sud Ouest) .. *(1950-51)* 144c
Defender (Aeronca) .. *(1945-46)* 199c
Defender (Fletcher) .. *(1956-57)* 280
Defiant (Boulton Paul) .. *(1945-46)* 21c
Delta (Sukhoi) 227
Delta 2 (Fairey) 78
Delta Dagger (Convair) 282
Delta Dart (Convair) 287
Delta Fighter (Sukhoi) .. *(1956-57)* 202
Deltaviex (Sud) .. .. *(1957-58)* 169
Demon (McDonnell) 339
Destroyer (Douglas) 295
DETEMPLE HELICOPTERS, INC. (U.S.A.) 290
Deux-Ponts (Breguet) 145
Devon (D.H.) 71
Discoplan (Sukhanov) 227
DITTMAR (see Möwe-Flugzeugbau Heini Dittmar) 175
DIVISION OF AIRCRAFT PRODUCTION, DEPARTMENT OF DEFENCE PRODUCTION (Australia) .. .. *(1957-58)* 114
Djinn (Sud) 172
DOAK AIRCRAFT CO. INC. (U.S.A.) 290
DOMAN HELICOPTERS, INC. (U.S.A.) 290
DORNIER (see Flug & Fahrzengwerke (1949-50) 180c
DORNIER, OFICINAS TECHNICAS (Spain) .. .. *(1955-56)* 200
DORNIER-WERKE G.m.b.H. (Germany) 176
DOUGLAS AIRCRAFT CO. INC. (U.S.A.) 292
Dove (D.H.) 71
Dragonfly (Westland) .. *(1957-58)* 110
Draken (Saab) 242
Drone (Aviolanda) 203
Drone (Beechcraft) .. *(1957-58)* 247
Drone (Kaman) 320
Drone (Radioplane) .. *(1957-58)* 349
Drone (Temco) .. .. *(1957-58)* 367
Drover (D.H. Australia) .. *(1953-54)* 109
DRUINE, ROGER (France) .. 151
Duchess (Saunders Roe) .. *(1951-52)* 75c
Duck GA-2 (Goodyear) .. *(1949-50)* 227c
Dumbo (G.C.A.) .. .. *(1951-52)* 158c
Durandal (Sud) 168

E

E.1/44 (Gloster) .. .. *(1949-50)* 56c
E-12 (Hispano) .. *(1957-58)* 231
E-14 (Hispano) 241
E-35 Bonanza (Beechcraft) .. *(1954-55)* 208
E50 Twin-Bonanza (Beechcraft) *(1957-58)* 246
E.114 Air Baby (Praga) .. *(1948)* 126c
E.117 (Praga) .. .. *(1948)* 126c
E.211 (Praga) .. .. *(1948)* 128c
EC-121 (Lockheed) .. *(1956-57)* 300
E.F. 100 (Eshelman) .. *(1948)* 256c
EF 150 Junkers (Russia) .. *(1954-55)* 188
EOLO 3V-1 (SIAI-Marchetti) .. 199
E.P.9 (Edgar Percival) 72
Eagle 3 (Slingsby) 102
EAST COAST AERONAUTICS INC. (U.S.A.) .. *(1956-57)* 277
EDGAR PERCIVAL AIRCRAFT LTD. (G.B.) 72
EDO CORPORATION (U.S.A.) *(1951-52)* 235c
EGYPTIAN STATE AIRCRAFT FACTORY .. .. *(1957-58)* 134
EIDG. FLUGZEUGWERK (Switzerland) 247
EKLUND, TOROLF (Finland) .. 139
Eksperimental (Letalski) .. *(1954-55)* 301

PAGE

El Boyero (Petrolini) .. *(1950-51)* 10c
Electra (Lockheed) 326
ELLIOTTS OF NEWBURY, LTD. (G.B.) 73
Elster (Putzer) 178
Emeraude (Piel) 165
EMIGH TROJAN AIRCRAFT COMPANY (U.S.A.) .. *(1951-52)* 235c
Emouchet (Minié) .. *(1951-52)* 139c
Emouchet-Escopette (Minié) .. *(1953-54)* 142
EMPRESA INDUSTRIAS AERONAUTICAS Y MECCANICAS DEL ESTADO (Argentine) .. *(1955-56)* 41
ENGINEERING & RESEARCH CORPORATION (U.S.A.) *(1954-55)* 245
ENGLISH ELECTRIC COMPANY LTD. (G.B.) 73
Ensign (All American) .. *(1948)* 215c
Eon (Elliotts) .. .. *(1950-51)* 54c
Epervier (Morane-Saulnier) .. 159
ERCOUPE (see Engineering & Research Corporation) .. .. *(1954-55)* 245
Espadon (Sud-Ouest) .. *(1953-54)* 154
Esquif (Fouga) 154
Essex Aero Sprite .. *(1948)* 59c
Estafette (Mignet) .. *(1953-54)* 43
Étendard II (Dassault) .. *(1956-57)* 134
Étendard IV (Dassault) 149
Étendard VI (Dassault) 149
Etabeta (G.C.A.) .. .. *(1954-55)* 166
Executive (On Mark) 359
Executive (Sparten) .. *(1949-50)* 278c
Executive (Stits) .. .. *(1955-56)* 316
Expeditor (Beechcraft) .. *(1955-56)* 217
Experimental Helicopter (Hungary) .. 184

F

F-1 Aircoupe (Forney) 304
F-1 Safari (Frye) .. *(1957-58)* 297
F-2 (Found) .. .. *(1949-50)* 101c
F2B (Boeing) .. .. *(1949-50)* 199c
F2H Banshee (McDonnell) .. *(1955-56)* 285
F2Y-1 Sea Dart (Convair) *(1957-58)* 253
F3D Skynight (Douglas) 238
F3H Demon (McDonnell) 339
F.4 (Ambrosini) .. .. *(1954-55)* 162
F4D Skyray (Douglas) 293
F4H (McDonnell) 339
F4U Corsair (Chance Vought) *(1952-53)* 188
F.5 (Caproni) .. .. *(1954-55)* 163
F5D Skylancer (Douglas) .. *(1957-58)* 284
F.6 (Pasotti) .. .. *(1957-58)* 190
F6U Pirate (Chance Vought) *(1950-51)* 213c
F.7 Rondone (Ambrosini) .. *(1957-58)* 184
F7F (Grumman) .. *(1948)* 265c
F7U (Chance Vought) .. *(1957-58)* 270
F.8L Falco (Aviamilano) 190
F8F Bearcat (Grumman) .. *(1949-50)* 229c
F8U Crusader (Chance Vought) .. 279
F.9 Sparviero (Pasotti) .. *(1957-58)* 191
F9F Cougar (Grumman) 308
F11F Tiger (Grumman) 307
F12 Baby (Larson) 321
F.14 Nibbio (Aviamilano) 189
F.24 (Fairchild) .. .. *(1948)* 259c
F.25 Promotor (Fokker) .. *(1949-50)* 154c
F-27 Friendship (Fairchild) .. 301
F.27 Friendship (Fokker) .. 204
F.35 Bonanza (Beechcraft) .. *(1955-56)* 215
F.47 (Fairchild) .. .. *(1948)* 259c
F.50 Twin Bonanza (Beechcraft) .. 257
F.80 Shooting Star (Lockheed) *(1955-56)* 279
F-82 Twin Mustang (North American) *(1950-51)* 266c
F.84 (Republic) .. .. *(1955-56)* 309
F-84 (Republic) .. .. *(1957-58)* 353
F-86 Sabre (North American) .. 351
F-89 Scorpion (Northrop) 356
F-93 (North American) .. *(1951-52)* 271c
F-94 (Lockheed) .. .. *(1956-57)* 307
F-95 Sabre (North American) *(1950-51)* 262c
F-96 Thunderjet (Republic) *(1950-51)* 277c
F-100 Super Sabre (North American) 349
F-101 Voodoo (McDonnell) 337
F-102 (Convair) 282
F.103 (Republic) .. .. *(1955-56)* 307
F.104 (Lockheed) 331
F-105 Thunderchief (Republic) .. 365
F.106 (Convair) 281
F.107A (North American) 349
F-108 (North American) 348
F-110 McDonnell .. *(1953-54)* 251
Fa-2 (Yugoslavia) 389
FA-2 Airphibian (Fulton) .. *(1952-53)* 209
FB-1 Gyrodyne (Fairey) .. *(1949-50)* 52c
FBA 1A (Found) .. *(1951-52)* 105c
FBA-2 (Found) .. .. *(1952-53)* 101
F.D.1 (Fairey) .. .. *(1952-53)* 61
F.D. 2 (Fairey) .. .. *(1955-56)* 75
FD-25-B (Fletcher) .. *(1956-57)* 280

PAGE

FES-530 (East Germany) .. *(1957-58)* 180
FFA (see FLUG & FAHRZEUGWERKE A.G.) 247
FH-1 Phantom (McDonnell) *(1950-51)* 252c
Fi 1 (Kockum) .. .. *(1948)* 199c
Fi 3 (Kockum) .. .. *(1948)* 199c
FJ Fury (North American) .. 352
F.L.3 (Lombardi) .. *(1949-50)* 147c
FL-23 (Fletcher) .. .. *(1951-52)* 239c
FL.53 (Meteor) 195
FL.54 (Meteor) 195
FL.55 (Meteor) 196
FL.55B (Meteor) 196
FN-333 (Nardi) 196
Fo.139 (Folland) .. *(1955-56)* 77
Fo.141 Gnat (Folland) 81
Fo.144 Gnat Trainer (Folland) .. 82
FR-1 Fireball (Ryan) .. *(1948)* 315c
FU-24 (Fletcher) 303
FABRICA MILITAR DE AVIONES (Argentine Republic) 43
FABRICA NACIONAL DE AERONAVES (Chile) 132
FABRIQUE FEDERALE D'AVIONS (Switzerland) .. .. *(1957-58)* 238
Faceplate (Russia) 223
Fachiro (Partenavia) 197
Fagot (MIG) .. .. *(1957-58)* 217
FAIRCHILD ENGINE & AIRPLANE CORPORATION (U.S.A.) .. 300
FAIREY AVIATION CO., LTD. (G.B.) 77
FAIREY AVIATION COMPANY OF AUSTRALASIA PTY. LTD. (Australia) 118
FAIREY AVIATION CO. OF CANADA LTD. (Canada) .. 129
Falco (Aviamilano) 190
Falcon Aircraft Manufacturing Company (see Baumann) .. 253
Family Cruiser PA-14 (Piper) *(1949-50)* 268c
FANAERO (see Fabrica Nacional de Aeronaves) (Chile) 132
Farfadet (Sud-Ouest) .. *(1955-56)* 163
FARMAN, SOCIÉTÉ ANONYME DES USINES (France) *(1957-58)* 149
Farmer (MIG) 223
Fauvette (Breguet) 147
FAWCETT AVIATION PTY., LTD. (Australia) .. .. *(1957-58)* 116
FEDERAL AIRCRAFT FACTORY (Switzerland) .. .. *(1957-58)* 238
FEDERALE (see Fabrique Fédérale d'Avions) .. .. *(1955-56)* 208
FIAT, SOCIETA PER AZIONI (Italy) 190
Finnmark (Honningstad) .. *(1952-53)* 147
Fireball (Ryan) .. .. *(1948)* 315c
Firebee (Ryan) 368
Firebrand (Blackburn) .. *(1951-52)* 27c
Firefly (Fairey) .. .. *(1956-57)* 71
Firefly T. Mk. 5 Trainer (Fairey, Australia) .. .. *(1955-56)* 112
Firefly Trainer (Fairey) .. *(1951-52)* 54c
Fishbed-A (Sukhoi) 227
Fishbed-B (Sukhoi) 227
Fishpot (Sukhoi) 228
Fitter (Soviet Union) 234
Five (Canadair) .. .. *(1955-56)* 117
Flamant (Dassault) .. *(1954-55)* 137
Flashlight (Yakovlev) 231
FLEET MANUFACTURING LTD. (Canada) .. .. *(1957-58)* 126
FLETCHER AVIATION CORPORATION (U.S.A.) 303
Fleuret (Morane-Saulnier) .. *(1956-57)* 145
Flora (Yakovlev) .. .. *(1956-57)* 206
FLUG & FAHRZEUGWERKE A.G. (Switzerland) 247
Flut-R-Bug (Stits) 376
Flying Atar (SNECMA) .. *(1957-58)* 164
Flying Automobile (Hall) .. *(1950-51)* 240c
Flying Boxcar (Fairchild) .. *(1954-55)* 246
Flying Platform (Hiller) 317
Flying Station Wagon (Stinson) *(1948)* 322c
Flying Vinta (Phillipines) 207
Flying Wing (Northrop) .. *(1951-52)* 277c
FLYRIDE (see Glenview Metal Products Co. (U.S.) .. *(1956-57)* 281
FOCKE-WULF G.m.b.H. (Germany) .. 176
FOKKER (N.V. Koninklijke Nederlandsche Vliegtuigen-Fabriek Fokker) 203
FOKKER INDUSTRIA AERONAUTICA S.A. (Brazil) 47
FOLLAND AIRCRAFT LTD. (G.B.) 81
Fonceur (Sud) .. .. *(1957-58)* 167
FORNEY MANUFACTURING COMPANY (U.S.A.) 304
FOUGA (see Potez Air-Fouga) .. 152
FOUND BROTHERS AVIATION LTD. (Canada) .. *(1952-53)* 101
Four Airliner (Canadair) .. *(1956-55)* 116
Frégate (S.N.C.A.N.) .. *(1953-54)* 116

PAGE

Freighter Type 170 (Bristol) (1955-56) 60
Freightship (Fokker) .. (1953-54) 169
Fresco (MIG) 223
Friendship (Fairchild) 204
Friendship F.27 (Fokker) 204
FRYE CORPORATION (U.S.A.) (1957-58) 297
FUJI JUKOGYO KABUSHIKI KAISHA (Japan) 200
Fulgur (Breguet) .. .. (1951-52) 118c
FULTON (see Continental Inc.) (1952-53) 209
FUNK AIRCRAFT COMPANY (U.S.A.) .. .. (1955-56) 234
Fury (Hawker) .. .. (1951-52) 66c
Fury Trainer (Hawker) .. (1948) 72c
Fury FJ-1 (North American) (1949-50) 259c
Fury FJ (North American) .. 352

G

G.11 E Gyroplane (Breguet) (1949-50) 117c
G.12 (Fiat) .. .. (1950-51) 150c
G-21-C Goose (McKinnon) 341
G.41 Meteor (Gloster) .. (1956-57) 76
G.43 Meteor Trainer (Gloster) (1951-52) 58c
G-44A (Grumman) .. (1948) 268c
G.46 (Fiat) .. .. (1956-57) 174
G.47 Javelin (Gloster) .. (1955-56) 79
G.49 (Fiat) .. .. (1956-57) 174
G.51 (Grumman) .. .. (1948) 265c
G.55 (Fiat) .. .. (1950-51) 153c
G.58 Bearcat (Grumman) .. (1949-50) 229c
G.59 (Fiat) .. .. (1956-57) 173
G.61 (Fiat) .. .. (1950-51) 154c
G.63 Kitten (Grumman) .. (1949-50) 229c
G.64 Albatross (Grumman) .. 311
G.70 Guardian (Grumman) .. (1949-50) 229c
G.72 Kitten (Grumman) .. (1949-50) 229c
G-73 Mallard (Grumman) .. (1951-52) 246c
G.79 Panther (Grumman) .. (1955-56) 263
G.80 (Fiat) .. .. (1955-56) 168
G.81 (Fiat) .. .. (1953-54) 160
G.82 (Fiat) .. .. (1957-58) 186
G.82 Guardian (Grumman) .. (1955-56) 265
G-89 Tracker (Grumman) 309
G.91 (Fiat) 191
G-93 Cougar (Grumman) 308
G-98 Tiger (Grumman) 307
G-159 Gulfstream (Grumman) .. 306
G-164 Ag-Cat (Grumman) .. 306
G.212 Aula Volante (Fiat) .. (1951-52) 156c
G.212 CP and TP (Fiat) .. (1951-52) 155c
GA.2 Duck Goodyear) .. (1949-50) 227c
G.A.5 Javelin (Gloster) 82
GA-22 (Goodyear) .. (1952-53) 210
GA-400R-3 Gizmo (Goodyear) .. 305
GA-447 (Goodyear) .. (1957-58) 298
G.A.L. 56 (General Aircraft) (1948) 63c
G.A.L. 60 (Blackburn) .. (1949-50) 30c
G.A.L. 61 (Blackburn) .. (1949-50) 31c
GC 1B Swift (Temco) .. (1951-52) 292c
G.C.A. (see Gruppo Construzioni Aeronautiche) .. .. (1954-55) 166
G.C.A. 1 Pedro (G.C.A.) .. (1951-52) 158c
G.C.A. 2 Dumbo (G.C.A.) .. (1951-52) 158c
G.C.A. 2A (Gyrodyne) .. (1952-53) 214
G.C.A. 2C (Gyrodyne) .. (1954-55) 255
G.C.A. 3 (Gyrodyne) .. (1953-54) 239
G.C.A. 3 (G.C.A.) .. (1954-55) 166
G.C.A. 7 Helidyne (Gyrodyne) (1951-52) 247c
G.F.4 Rondone (Ambrosini) (1952-53) 138
G.G.7 (Gripo) 192
G.I.L. Pegaz (Poland) .. (1951-52) 168c
G.I.L. Zurakowski Helicopter (Poland) (1951-52) 167c
GMP-1 (Flyride) .. (1954-55) 249
GMP-2 (Flyride) .. (1956-57) 281
GMP-2 (Flyride) .. (1957-58) 281
G.R. 17 (Fairey) .. 1950-51) 56c
GY-20 (C.A.B.) .. .. (1956-57) 132
GY-30 (C.A.B.) .. .. (1956-57) 133
Gafanhoto (I.P.T.) .. (1951-52) 12c
GAIL AIRCRAFT ENGINEERING CO. (U.S.A.) 304
Gannet (Fairey) 78
GATARD (France) 154
Gebics (Hungary) 184
Gerfaut 1 (Nord) .. (1956-57) 147
Gerfaut 11 (Nord) 160
Gemeaux (Fouga) .. .. (1953-54) 136
Gemini (Miles) .. .. (1948) 79c
GENERAL AIRPLANE SERVICE (U.S.) .. .. (1954-55) 249
Gerfaut I (Nord) .. (1957-58) 158
Gerfaut II (Nord) .. (1957-58) 159
Gizmo (Goodyear) 305
GLENVIEW METAL PRODUCTS CO. (U.S.) .. .. (1956-57) 281
GLENN L. MARTIN CO. (U.S.A.) (1956-57) 313
Globe (see Temco) .. (1948) 323c

PAGE

Globemaster 1 (Douglas) .. (1951-52) 226c
Globemaster 11 (Douglas) 292
GLOSTER AIRCRAFT CO., LTD. (G.B.) 82
Gloster Meteor Trainer .. (1948) 66c
Gloster Meteor .. .. (1948) 64c
Gloster E.1/44 .. .. (1948) 64c
GLUHAREFF HELICOPTER CORP. (U.S.A.) 305
Gnat (Folland) 81
Gnat Trainer (Folland) 82
Goeland (Nord) .. .. (1948) 150c
Gomhouria (United Arab Republic) .. 138
GOODYEAR AIRCRAFT CORPORATION (U.S.A.) 305
Goose (McKinnon) 341
Gorgan IV (Martin) .. (1949-50) 254c
Gouvernour (Sud) 172
GOVERNMENT FACTORIES (Australia) 119
GOVERNMENT FACTORIES (Yugoslavia) 387
GOVERNMENT WORKSHOPS (Portugal) 214
Grace (AICHI) .. .. (1945-46) 156c
Grand Tourisme (Jodel) 164
Griffon (Nord) 160
Grifo S.1001 (Ambrosini) .. (1951-52) 152c
Grillon (Aubert) 129
Grippo (see Compagnia Generale Ellettrodomestici) 192
Grognard S.E. 2410 (Sud-Est) (1952-53) 130
GRUMMAN AIRCRAFT ENGINEERING CORPORATION (U.S.A.) 306
Grunau Baby IIB (East Germany).. 183
GRUPPO CONSTRUZIONI AERONAUTICHE (Italy) .. (1954-55) 166
Guardian (Grumman) .. (1955-56) 265
Guion (Hispano) 240
Gulfstream (Grumman) 306
Gull (Trecker) 382
Gull 4 (Slingsby) .. (1953-54) 93
Gyor 2 (Hungary) 184
Gyro-Boat (Bensen) 262
Gyro-Copter (Bensen) 263
Gyro-Glider (Bensen) 262
Gyrodyne (Jacobs) .. (1955-56) 280
Gyrodyne (Fairey) .. (1949-50) 52c
GYRODYNE COMPANY OF AMERICA, INC. (U.S.A.) 312
Gyroplane (Breguet) .. (1952-53) 112

H

H-2 (SOBEH) .. .. (1955-56) 184
H-2 (Landgraf) .. .. (1949-50) 236c
H-2 (N.H.I.) .. .. (1956-57 191
H-3 (N.H.I.) 206
H-4 (Sikorsky) .. .. (1949-50) 277c
H-5 (Sikorsky) .. .. (1954-55) 292
H-10 (Atlas) .. .. (1949-50) 189c
H-12 (Bell) .. .. (1953-54) 178
H-13 (Bell) 259
H-13D (Bell) .. .. (1951-52) 201c
H-13G (Bell) .. .. (1955-56) 220
H-13J (Bell) 261
H-19 (Sikorsky) 374
H-21 Shawnee (Vertol) 383
H-23 (Hiller) 316
H-25A Army Mule (Vertol) .. 382
H-31 (Doman) .. .. (1957-58) 281
H-34 (Sikorsky) .. .. (1957-58) 361
H35 Bonanza (Beechcraft) .. (1957-58) 344
H-37 (Sikorsky) .. .. (1957-58) 360
H-37A Mojave (Sikorsky) 372
H-39 (Sikorsky) .. .. (1955-56) 314
H-43 (Kaman) 320
H-391B (Helio) 314
H-392 (Helio) 314
H.A.001 Libel (Hollandair) .. 205
HA-43 (Hispano) .. (1955-56) 201
HA-44-B1 (Hispano) .. (1950-51) 181c
HA-100 (Hispano) 240
HA-200-R1 (Hispano) 241
HA-231-R1 (Hispano) 240
HA-1109 Buchon (Hispano) (1957-58) 230
HA-1109 JL (Hispano) .. (1951-52) 182c
HC-1 (Doman Frasier) .. (1948 245c
HC-2 Heli-Baby (Czechoslovakia) .. 137
HC-3 (Czechoslovakia) 137
H.D.10 (Hurel-Dubois) .. (1951-52) 127c
H.D.31 (Hurel-Dubois) .. (1954-55) 140
H.D.32 (Hurel-Dubois) .. (1955-56 144
H.D.34 (Hurel-Dubois) 155
H.D.35 (Hurel-Dubois) .. (1955-56) 144
H.D.45 (Hurel-Dubois) .. (1954-55) 141
H.D.321 (Hurel-Dubois) 155
H.D.322 (Hurel-Dubois) 155
HD 153 Möwe (Dittmar) .. (1957-58) 173
HD 156 Möwe (Dittmar) .. (1957-58) 173

PAGE

HDM.105 (Miles).. 95
HDM.106 Caravan (Miles) 95
HDM.107 Aerojeep (Miles) (1957-58) 94
H.F. XX-02 (Chile) .. (1956-57) 120
HFB 209 (Hamburger) .. (1957-58) 174
HJ-1 Hornet (Hiller) 315
HK-1 (Heinonen) 139
HK-2B (Fuji) .. .. (1955-56) 177
HL-1 Series B (C.N.N.A.) (1951-52) 12c
HL-3 Series (C.N.N.A.) .. (1949-50) 11c
H.M.1 (AISA) .. .. (1951-52) 180c
H.M.2 (AISA) .. .. (1951-52) 180c
H.M.3 (AISA) .. .. (1951-52) 180c
H.M.5 (AISA) .. .. (1951-52) 180c
H.M.7 (AISA) .. .. (1951-52) 180c
H.M.9 (AISA) .. .. (1951-52) 181c
H.M.310 (Mignet) .. (1953-54) 43
HNS-1 (Sikorsky) .. (1949-50) 277c
HO2S-1 (Sikorsky) .. (1949-50) 278c
HO3S-1 (Sikorsky) .. (1954-55) 292
HO4S-1 (Sikorsky) 374
HO5S-1 (Sikorsky) .. (1954-55) 274
HOE-1 (Hiller) 315
HOK-1 (Kaman) 320
H.P.67 Hastings (Handley Page) (1954-55) 78
H.P.80 Victor (Handley Page) .. 84
H.P.81 Hermes 4 (Handley Page) (1953-54) 79
H.P.82 Hermes 5 (Handley Page) (1952-53) 68
H.P.97 (Handley Page) .. 1953-54) 77
H.P.113 (Handley Page) 84
H.P.R.2 (Handley Page) .. (1951-52) 62c
H.P.R.3 Herald (Handley Page) (1957-58) 83
H.P.R.5 (Handley Page) .. (1955-56) 84
HRP (Vertol) .. .. (1956-57) 345
HRS (Sikorsky) 374
HR2S-1 (Sikorsky) 372
HS-42-B (Hispano) .. (1949-50) 174c
HSL (Bell) .. .. (1957-58) 252
HSL-1 (Bell) 262
HSS-1 (Sikorsky) 371
HSS-2 (Sikorsky) 371
HT-2 (Hindustan) 131
HT-10 (Hindustan) .. (1954-55) 122
HTE (Hiller) 316
HTK-1 (Kaman) .. (1957-58) 331
HTL (Bell) 259
HTL 6 (Bell) .. .. (1955-56) 220
HTL-7 (Bell) .. .. (1957-58) 251
HU-1A Iroquois (Bell) 259
HU2K-1 (Kaman) 319
HUK-1 (Kaman) 320
HUL (Bell) .. .. (1957-58) 251
HUL-1 (Bell) 261
HUP Retriever (Vertol) 382
HUS-1 (Sikorsky) 371
HUS-2 (Sikorsky) 371
Halcon (CASA) 238
Halton (Handley Page) .. (1948) 70c
HAMBURGER FLUGZEUGBAU G.m.b.H. (Germany) 176
HANDLEY PAGE LTD. (G.B.) .. 84
HANDLEY PAGE (READING) LTD. (G.B.) 84
Hare (Mil') 225
Harvard (North American) .. (1948) 304c
Hastings (Handley Page) 86
Hat (Kamov) 222
HAWKER AIRCRAFT LTD. (G.B.) 87
HAWKER AIRCRAFT (BLACKPOOL) LTD. (G.B.) .. (1957-58) 85
HAWKER SIDDELEY GROUP LTD. (G.B.) 89
HAYDEN AIRCRAFT CORP. (U.S.A.) 312
HAYES AIRCRAFT CORP. (U.S.A.) 313
HEINKEL, ERNST, FAHRZEUGBAU G.m.b.H. (Germany) .. 177
HEINON, JUHANI (Finland) .. 139
Helidyne (Gyrodyne) .. (1953-54) 239
Heli-Vector (De Lackner) .. (1955-56) 246
Heli-Baby (Czechoslovakia) .. (1957-58) 132
HELIO AIRCRAFT CORPORATION (U.S.A.) 313
HELIOPLANE (see Helio Corporation) (1951-52) 248c
Hen (Kamov) 222
HENSCHEL UND SOHN G.m.b.H. (Germany) .. .. (1956-57) 165
Herald (Handley Page) .. (1957-58) 83
Hercules (Lockheed) 324
Hermes 4 (Handley Page) .. (1953-54) 79
Hermes 5 (Handley Page) .. (1953-54) 68
Heron (D.H.) 67
HESTON AIRCRAFT CO., LTD. (G.B.) .. .. (1951-52) 69c
HILLER AIRCRAFT CORPORATION (U.S.A.) 314
Hiller 360 (United Helicopters) (1948) 269c
HINDUSTAN AIRCRAFT PRIVATE LTD. (India) 131


in every phase of aviation . . .
Dunlop has served
the aviation industry for over
forty five years. During that time a
tradition of careful design and high quality production
has gained the confidence of aircraft
engineers and operators all over the world.
Now the range of Dunlop Aviation Equipment embraces
tyres (including tubeless), wheels and brakes,
'Maxaret' anti-skid units, a complete selection of pneumatic control valves
and actuators for all aircraft services, rubber
accessories, flexible pipes, windscreen wiper and de-icing systems.
In the latest phase of aeronautical science, the production of guided missiles and research rockets,
many Dunlop components are being used and new types are under development.
All this equipment emphasizes the important contribution Dunlop is making to aviation.
DUNLOP plays a part

PAGE

HISPANO AVIACION S.A. LA (Spain) 240
Hodek (Czechoslovakia) .. *(1948)* 128c
Hog (Kamov) 222
Holiday (Starck) .. .. *(1953-54)* 149
HOLLANDAIR T.B. (Netherlands) .. 205
HOLSTE, AVIONS MAX (France) *(1957-58)* 156
Honey Bee (Bee) .. *(1955-56)* 215
HONNINGSTAD (see Norsk Flyindustri S/A) .. .. *(1955-56)* 184
Honza (Czechoslovakia) .. *1949-50)* 107c
Hook (Mil) 226
Hoppi-copter C-1 (Capital) .. *(1955-56)* 229
HOPPI-COPTERS INC. (see Capital) *(1954-55)* 220
Hornet (D.H.) .. .. *(1951-52)* 45c
Hornet (Hiller) 315
Horse (Yakovlev) 231
Hound (Mil) 225
Hoverfly (Sikorsky) .. *(1949-50)* 277c
HOWARD AERO INC. (U.S.A.) .. 317
Huanquero (Instituto Aerotecnico) .. 45
HUGHES AIRCRAFT CO. (U.S.A.) 257 *(1955-56)* 85
HUGHES TOOL COMPANY, AIRCRAFT DIVISION (U.S.A.) .. 318
Hunter (Hawker) 87
HUNTING AIRCRAFT, LTD. .. 89
HUNTING PERCIVAL AIRCRAFT LTD. (G.B.) .. .. *(1957-58)* 87
HUREL-DUBOIS SOCIÉTÉ DE CONSTRUCTION DES AVIONS (France 155
Hustler (Convair) 283
Hydro-Glider (Bensen) 262

I

I-11 (AISA) .. .. *(1955-56)* 198
I-11B (AISA) .. .. *(1957-58)* 227
I-115 (AISA) .. .. *(1957-58)* 227
I.A. (see Fabrica Militar de Aviones) (Argentine) .. .. *(1957-58)* 43
I.A.M.E. (see Empresa Industrias Aeronauticas y Meccanicas del Estado) *(1955-56)* 41
I.A.R. 811 (Rumania) .. *(1953-54)* 150
I.A.R. 811 (Hungary) 214
I.A.R. 813 (Hungary) 214
I.A.R. 814 (MR-2) (Hungary) .. 214
I.A.R. 817 (Hungary) 214
I.Ae.24 Calquin (Instituto Aerotecnico) *(1951-52)* 9c
I.Ae.27 Pulqui 1 (Instituto Aerotecnico) *(1951-52)* 8c
I.Ae.30 Namcu (Instituto Aerotecnico) *(1951-52)* 7c
I.Ae.31 Colibri (Instituto Aerotecnico) *(1951-52)* 9c
I.A.33 Pulqui 11 (Instituto Aerotecnico) *(1956-57)* 40
I.A.34 Clen Antu (Instituto Aerotecnico) *(1956-57)* 39
I.A.35 (Instituto Aerotecnico) .. 45
I.A.37 (Instituto Aerotecnico) .. 43
I.A.38 (Instituto Aerotecnico) .. 44
I.A.41 (Urubú) .. .. *(1956-57)* 39
I.A.45 (Instituto Aerotecnico) .. 43
I.A.46 (Instituto Aerotecnico) . 43
I.A.R.811 (Rumania) .. *(1957-58)* 208
I.A.R.813 (Rumania) .. *(1957-58)* 208
I.A.R.814 (Rumania) .. *(1957-58)* 208
I.A.R.817 (Rumania) .. *(1957-58)* 208
I.Ae.DL.22 (Instituto Aerotecnico) *(1951-52)* 9c
I-G (Transcendental) .. *(1956-57)* 344
IL-2 (Ilyushin) .. .. *(1949-50)* 163c
IL-10 Shturmovik (Ilyushin) *(1955-56)* 191
IL-11 (Ilyushin) .. *(1950-51)* 168c
IL-12 (Ilyushin) 221
IL-14 (Ilyushin) 220
IL-14P (East Germany) 182
IL-18 (Ilyushin) 220
IL-20 (Ilyushin) .. .. *(1957-58)* 214
IL-28 (Ilyushin) 219
IL-28U (Ilyushin) 220
IM-99 Bomarc (Boeing) 270
IP-2 (Iberavia) .. .. *(1951-52)* 183c
I.P.T. (see Instituto de Pesquisas Tecnologicas) 47
I.P.T. 0 Bichinho .. *(1951-52)* 12c
I.P.T. 1 Gafanhoto .. *(1951-52)* 12c
I.P.T. 2 Aratinga .. *(1951-52)* 12c
I.P.T. 3 Saracura .. *(1951-52)* 12c
I.P.T. 4 Planalto .. *(1951-52)* 12c
I.P.T. 5 Jaraguá .. *(1951-52)* 12c
I.P.T. 6 Stratus .. *(1951-52)* 13c
I.P.T. 7 Junior .. .. *(1951-52)* 13c
I.P.T. 8 .. .. *(1951-52)* 13c
I.P.T. 9 .. .. *(1951-52)* 13c
I.P.T. 10 Junior .. .. *(1951-52)* 13c
I.P.T. 11 Bivhão .. *(1951-52)* 13c

PAGE

I.P.T. 12 Caboré .. *(1951-52)* 14c
I.P.T. 13 .. .. *(1951-52)* 14c
I.P.T. 14 Marréco .. *(1951-52)* 14c
I.P.T. 16 and 17 47
IS-1 Sep (Poland) .. *(1953-54)* 174
IS-2 Mucha (Poland) .. *(1953-54)* 174
IS-3 ABC (Poland) .. *(1957-58)* 206
IS-3 ABC-A (Poland) 212
IS-4 Jastrzab (Poland) .. *(1953-54)* 174
IS-5 Kaezka (Poland) .. *(1951-52)* 168c
IS-6-X Nietoperz (Poland) .. *(1953-54)* 174
IBERAVIA S. A. (Spain) .. *(1954-55)* 195
Ifjusag (Hungary) 184
Ikarus (Yugoslavia) 387
ILYUSHIN, SERGEI (Soviet Union) .. 219
Ilyushin Jet-propelled Bomber (Ilyushin) *(1948)* 182c
INDONESIAN AIR FORCE, TECHNICAL STAFF .. *(1955-56)* 165
INDRAERO, SOCIÉTÉ (France) *(1956-57)* 141c
Industriewerk IL-14P (East Germany) *(1957-58)* 179
Inflatable (Goodyear) .. *(1956-57)* 283
Inflatoplane (Goodyear) 305
Inta H.M.1 (AISA) .. *(1951-52)* 180
Inta H.M.2 (AISA) .. *(1952-53)* 180
Inta H.M.3 (AISA) .. *(1952-53)* 180
Inta H.M.5 (AISA) .. *(1952-53)* 180
Inta H.M.7 (AISA) .. *(1952-53)* 180
Inta H.M.9 (AISA) .. *(1952-53)* 181
INSTITUTE OF SCIENCE AND TECHNOLOGY (Philippine Republic) 207
INSTITUTE OF TECHNICAL RESEARCH (Brazil) .. *(1957-58)* 46
INSTITUTO AEROTECNICO (Argentine Republic) see FABRICA MILITAR DE AVIONES) 43
INSTITUTO DE PESQUISAS TECNOLOGICAS (Brazil) 47
INSTITUTO DI AERONAUTICA POLITECNICO DI MILANO (Italy) .. .. *(1951-52)* 154c
INSTRUMENTS DE PRECISION M.D.G. (France) .. *(1951-52)* 130c
Inta (see AISA) .. *(1951-52)* 180c
Integral (Breguet) .. *(1956-57)* 145
Iroquois (Bell) 259
Iskra (Poland) 208

J

J/1 Autocrat (Auster) .. *(1955-56)* 50
J1N Alpha (Auster) .. *(1957-58)* 52
J/1 Helicopter (McDonnell) *(1950-51)* 253c
J/1U Workmaster (Auster) 53
J/2 Arrow (Auster) .. *(1951-52)* 20c
J-2-L1 Jupiter (Jamieson) *(1951-52)* 250c
J/4 (Auster) .. .. *(1951-52)* 20c
J/5 Autocar (Auster) .. *(1957-58)* 53
J/5E Aiglet Trainer (Auster) *(1957-58)* 52
J21A (Saab) .. .. *(1951-52)* 187c
J21RA and RB (Saab) .. *(1951-52)* 186c
J29 (Saab) 244
J-32 (Saab) 243
J-35 (Saab) 242
J32 Lansen (Saab) .. *(1957-58)* 234
J.D.M. AVIONS France) *(1951-52)* 127c
JK-1 Trzmiel (Poland) 212
JOV-3 .. .. *(1950-51)* 243c
JR2F-1 Albatross (Grumman) *(1945-50)* 230c
JRM-1 and -2 Mars (Martin) *(1951-52)* 267c
Jac (Starck) .. .. *(1948)* 155c
Jack (Mitsubishi) .. *(1945-46)* 162c
Jackaroo (Jackaroo) 92
JACKAROO AIRCRAFT LTD. (G.B.) 92
JACOBS AIRCRAFT ENGINE CO. (U.S.A.) .. .. *(1956-57)* 292
Jaguar (Grumman) .. *(1953-54)* 235
Jalon (Fouga) .. .. *(1949-50)* 120c
JAMIESON AIRCRAFT COMPANY INC. (U.S.A.) .. *(1951-52)* 250c
Jaragua (I.P.T.) .. *(1951-52)* 12c
Jaskolka (Poland) .. *(1957-58)* 207
Jastrzab (Poland) .. *(1953-54)* 174
Javelin (Gloster) 82
Javelot WA-20 (Wassmer) .. *(1956-57)* 173
Jet Gyrodyne (Fairey) .. *(1956-57)* 73
Jet Mentor Beechcraft) 256
Jet Provost (Hunting) 89
Jetliner C.102 (Avro Canada) *(1952-53)* 95
Jetstar (Lockheed) 323
Jindivik (Australia) 119
JODEL, SOCIÉTÉ DES AVIONS (France) 156
Jodel-Wassmer D.120 (Wassmer) *(1957-58)* 171
JURCA MARCEL (France) .. 157
Junak (Poland) 210

PAGE

Junior (I.P.T.) .. .. *(1951-52)* 13c
Junior (Avions Fairey) .. *(1951-52)* 11c
JUNKERS FLUGZEUG-UND MOTORENWERKE G.m.b.H. (Germany) 177
Jupiter (Jamieson) .. *(1951-52)* 250c

K

K.17 Vertolet (Kamov) .. *(1955-56)* 191
K-16B (Kaman) 319
K-17 (Kaman) 319
K-125-A (Kaman) .. *(1948)* 273c
K-190 (Kaman) .. .. *(1949-50)* 236c
K-225 (Kaman) .. .. *(1953-54)* 243
K-600 (Kaman) 321
KA-10 (Kamov) 222
KA-10M (Kamov) 222
KA-15 (Kamov) 222
KA-18 (Kamov) 222
KAL-2 (Kawasaki) .. *(1956-57)* 183
KAQ-1 (Kawasaki) .. *(1955-56)* 178
KAT-1 (Kawasaki) .. *(1956-57)* 183
KB-6 (Yugoslavia) 390
KB-9 (Letalski) .. .. *(1954-55)* 301
KB-50J Superfortress (Hayes) .. 313
KC-97 (Boeing) .. .. *(1957-58)* 261
KC-135 Stratotanker (Boeing) .. 264
KD2R (Radioplane) 362
KDA-1 (Ryan) 368
KDM-1 Plover (Martin) .. *(1953-54)* 229
KH-2 (Kellett) .. .. *(1948)* 274c
KH-3 (Kellett) .. .. *(1948)* 273c
KH-15 (Kellett) .. *(1957-58)* 313
KI.107 (Klemm) 177
KI.107B (Klemm) 177
KS-3 (Kingsford Smith) 120
KTS-20 (Tsibin) .. *(1952-53)* 155
KZ (see Skandinavisk Aero Industri KA/S .. .. *(1957-58)* 134
KZ A.O.P. (KZ) .. .. *(1951-52)* 112c
KZ II-T (KZ) .. .. *(1949-50)* 108c
KZ VII Lark (KZ) .. *(1956-57)* 127
KZ VIII (KZ) .. *(1951-52)* 113
KZ X (KZ) .. .. *(1955-56)* 127
Kaczka (Poland) .. .. *(1951-52)* 168c
KAMAN AIRCRAFT CORPORATION (U.S.A.) .. *(1957-58)* 310
KAMAN AIRCRAFT OF CANADA, LTD. 318
KAMOV, N.I. (Soviet Union) .. 222
Kania 2 (Poland) 209
Kanya (Aero-Ever) .. *(1952-53)* 149
Kanya (Hungary) .. *(1956-57)* 168
Kaplick-Kerl (East Germany) .. 183
Karhu 48 (Karhumaki) .. *(1954-55)* 127
Karhu 48B (Karhumaki) .. *(1955-56)* 128
Karhu 49 (Karhumaki) .. *(1953-54)* 123
KARHUMAKI (see Veljekset Karhumaki O/Y) .. .. *(1955-56)* 128
Katy (Payen) .. .. *(1957-58)* 162
KAWASAKI KOKUKI KOGYU K.K. (Japan) 201
Kek Madar (Hungary) .. *(1956-57)* 168
KELLETT AIRCRAFT CORPORATION (U.S.A.) 321
Kingfisher (Lockheed) 337
KINGSFORD SMITH AVIATION SERVICE PTY., LTD. (Australia) 120
Kirby Cadet (Slingsby) .. *(1954-55)* 96
Kirby Tutor (Slingsby) .. *(1957-58)* 101
Kitten (Grumman) .. *(1949-50)* 229c
KLEMM FLUGZEUBAU, LEICHFLUGZEUGBAUKLEMM G.m.b.H. (Germany) 177
Kmotr L.G.30 (Czechoslovakia) *(1951-52)* 108c
Kolibri Borgward 174
Kolibrie (N.H.I.) 206
Koma (Hungary) 184
KONINKLIJKE NEDERLANDSCHE VLIEGTUIGEN-FABRIEK FOKKER (Netherlands) .. *(1955-56)* 182
Kos (Poland) 208
Kotlinski Trzmiel (Poland) .. *(1957-58)* 206
KOVO LIMITED (Czechoslovakia) *(1951-52)* 108c
Krajanek (Czechoslovakia) .. *(1949-50)* 107c
Kunang (Indonesia) 186
KUPFER, M.A. (Russia) *(1953-54)* 177
Kurir (Yugoslavia) 388
KUZAKOV, M.A. (Soviet Union) .. 222

L

L-10B (Philippine) .. *(1955-56)* 185
L-13 Blanik (Convair) 137
L-16 (Aeronca) .. .. *(1950-51)* 197c
L-17 Navion (Ryan) .. *(1952-53)* 242
L-M (Philippines) .. *(1956-57)* 192

PAGE

L-18 (Piper) .. .. *(1955-56)* 303
L-19 Bird Dog (Cessna) 273
L-19A (Cessna) .. .. *(1956-57)* 247
L-20 Beaver (D.H. Canada) .. 128
L-21 (Piper) .. .. *(1955-56)* 303
L-21S Flying Vinta (Philippines) .. 207
L-23 Seminole (Beechcraft) .. 256
L-23 (Beechcraft) 246
L-23B (Beechcraft) .. *(1956-57)* 231
L26 (Aero) 250
L-26C (Aero) 251
L-27A (Cessna) 274
L-40 Meta-Sokol (Czechoslovakia) *(1957-58)* 130
L-55 (Aer Lualdi) 193
L-60 Brigadyr (Czechoslovakia) .. 134
L.101 (Czechoslovakia) .. *(1952-53)* 105
L.101 Air Tractor (Lansom) *(1957-58)* 313
L.107 Lunak (Czechoslovakia) *(1952-53)* 104
L-200 Morava (Czechoslovakia) .. 136
L-208 (Czechoslovakia) 133
L.290 Orel (Czechoslovakia) *(1952-53)* 105
L.3805 Commander (Aero) .. *(1953-54)* 195
L.A.4a Minor (Pheonix) 96
L.A.5 Major (Phoenix) 96
LA-5 (Lavochkin) .. *(1948)* 187
LA-7 (Lavochkin) .. *(1949-50)* 165c
LA-9 (Lavochkin) .. *(1953-54)* 177
LA-11 (Lavochkin) .. *(1954-55)* 183
La-16 Lerche (East Germany) *(1957-58)* 179
La-17 (East Germany) .. *(1957-58)* 179
LA-17 (Lavochkin) .. *(1954-55)* 183
LAZ-7 (Lazarow 132
LAZ-7M (Lazarow) 132
LAZ-8 (Lazarow) 132
LAZ-10H (Lazarow) 132
LC-126A (Cessna) .. *(1954-55)* 222
LD.26 (M.D.G.) .. *(1948)* 142c
LD-40 Meta-Sokol (Caechoslovakia) .. 134
LF 109 Pionyr (Czechoslovakia) *(1954-55)* 125
LFIL (Rumania).. 214
LG30 Kmotr (Czechoslovakia) *(1951-52)* 108c
LG 125 Sohaj 2 (Czechoslavakia) *(1953-54)* 120
LK-1 (Yugoslavia) 390
LI-2 (Russian DC-3) .. *(1948)* 195c
LM-1 (Fuji) 201
LM-II Supernikko (Fuji) 201
L.M.5 (Lombardi) .. *(1949-50)* 147c
LO 100 Zwergreiher (Burgfalke) .. 175
LO-150 Zwergreiher (Burgfalke) .. 175
LOM-55 Libelle (East Germany) *(1957-58)* 180
L.M.7 (Lombardi) .. *(1950-51)* 155c
LS-50 (Legrand-Simon) 157
L-Spatz-55 (Scheibe) 180
LWD Junak (Poland) 210
LWD Zuraw (Poland) .. *(1957-58)* 203
LZ-1A (Doman) .. *(1949-50)* 213c
LZ-2A Pelican (Doman) .. *(1949-50)* 213c
LZ-4A (Doman) .. .. *(1952-53)* 197
I.Z-5 (Doman) 290
LAMSON AIRCRAFT CO., INC. (U.S.A.) .. .. *(1957-58)* 313
Lancastrian (Avro) .. *(1948)* 29c
Landmann La-16 Lerche (East Germany) *(1957-58)* 179
Landmann La-17 (East Germany) *(1957-58)* 179
Langley Twin-Four .. *(1948)* 276c
Languedoc (Sud-Est) .. *(1951-52)* 143c
Lansen (Saab) 243
Lark (KZ) .. .. *(1955-56)* 127
LARSON AERO DEVELOPMENT (U.S.A.) 321
LATECOERE SOCIETE INDUSTRIELLE D'AVIATION (France) *(1951-52)* 129c
Latécoere 631 .. .. *(1948)* 141c
LAVOCHKIN, SEMYON A (Russia) *(1954-55)* 183
LAZAROW, ENG. CWIETAN (Bulgaria) 132
LEAR, INC. (U.S.A.) .. *(1957-58)* 314
Learke (Skandinavisk Aero Industri) *(1948)* 130c
LEARSTAR (see PACAERO ENGINEERING CORPORATION .. 322
Learstar Mk. I (Pac Aero).. .. 322
Learstar Mk. II (Pac Aero) .. 322
LEDUC ET FILS, RENÉ (France) .. 157
LEGRAND-SIMON (see Paul Legrand (France) 157
Lehrmeister (East Germany) .. 182
Leonides Herald (Handley Page) *(1957-58)* 83
Lerche (East Germany) .. *(1957-58)* 179
LETALSKI KONSTRUKCIJSKI BIRO (Yugoslavia) .. *(1954-55)* 300
Libel (Hollandair) 205
Libelle (East Germany) 183
Liftmaster DC.6A (Douglas) *(1951-52)* 230c
Light Aircraft (ML) .. *(1956-57)* 86
Lightning (English Electric) .. 73

PAGE

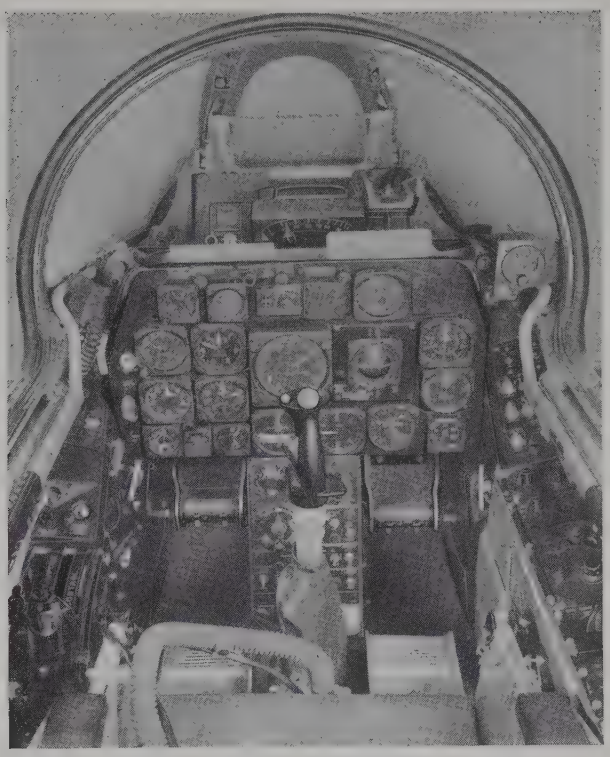
Lincoln (Avro) .. .. *(1951-52)* 25c
Little Henry (McDonnell) .. *(1951-52)* 251c
Little Pink Cloud (Billman) .. 263
Little Toot (Meyer) 345
Loadmaster (Cancargo) .. *(1951-52)* 104c
LOCKHEED AIRCRAFT CORPORATION (U.S.A.) 322
Loisirs (Adam) .. .. *(1957-58)* 127
LUALDI (see Aer Lualdi & C.) .. 193
Lunak L.107 (Czechoslovakia) *(1952-53)* 104
Lurko (Hungary) .. *(1956-57)* 168
LUSCOMBE AIRPLANE CORPORATION (U.S.A.) .. *(1952-53)* 224
Luton L.A. 4a Minor (Phoenix) .. 96
Luton L.A.5 Major (Phoenix) .. 96

M

McCULLOCH MOTORS CORPN. AIRCRAFT DIVISION (U.S.A.) *(1954-55)* 268
McDONNELL AIRCRAFT CORPORATION (U.S.A.) .. *(1956-57)* 310
McKINNIE AIRCRAFT (U.S.A.) *(1955-56)* 287
McFARLAND AIRCRAFT CO. (U.S.A.) .. .. *(1952-53)* 262
M-1 (Sud-Ouest) .. .. *(1951-52)* 146b
M-1-D Sokol (Czechoslovakia) *(1953-54)* 120
M.2 (Sud-Ouest) .. .. *(1951-52)* 143c
M.2 Skaut (Czechoslovakia) *(1951-52)* 109c
M-2 (Poland) 209
M-3 Pliszka (Poland) 209
M-4 (Poland) 209
M.3 Bonzo (Czechoslovakia) *(1950-51)* 112c
M-14 Helicopter (Marquardt) *(1951-52)* 262c
M-18 C55 (Mooney) .. *(1956-57)* 317
M-20 (Mooney) .. .. *(1957-58)* 336
M.38 (Miles) .. .. *(1948)* 31c
M.57 (Miles) .. .. *(1948)* 81c
M.60 (Miles) .. .. *(1948)* 80c
M.65 (Miles) .. .. *(1948)* 79c
M.68 (Miles) .. .. *(1948)* 78c
M.71 (Miles) .. .. *(1948)* 78c
M.75 (Miles) .. .. *(1955-56)* 91
M.77 (Miles) .. .. *(1955-56)* 91
M.100 Student/Centurian (Miles) .. 94
M.105 (Miles) .. .. *(1955-56)* 91
M-150 Schulmeister (Burgfalke) .. 175
M-185F (Fairchild) .. *(1957-58)* 294
M-224-1 (Fairchild) 301
MAC 125 (Meyers) .. *(1951-52)* 269c
MAK-15MP (Kuzakov) 222
M.B.70 (Brochet) .. *(1957-58)* 143
M.B.71 (Brochet).. .. *(1956-57)* 131
M.B.72 (Brochet).. .. *(1956-57)* 131
M.B.80 (Brochet) .. *(1957-58)* 143
M.B.80 A.B.C. (Dassault) *(1951-52)* 123c
M.B.100 (Brochet) .. *(1957-58)* 143
M.B.101 (Brochet) .. *(1957-58)* 143
M.B.110 (Brochet) 147
M.B.120 (Brochet) 147
M.B.308 (Macchi) .. *(1955-56)* 172
M.B.314 (Macchi) .. *(1948)* 170c
M.B.320 (Macchi) .. *(1956-57)* 176
M.B.323 (Macchi) .. *(1956-57)* 175
M.B.326 (Macchi) 194
MAK-15MP (Kuzakov) 222
MC-4 (McCulloch) .. *(1954-55)* 268
MC-101 (Matra-Cantineau) *(1953-54)* 142
MD-12 (Poland) .. .. *(1957-58)* 205
M.D.80 ABC (Dassault) .. *(1951-52)* 123c
M.D.311 (Dassault) .. *(1954-55)* 137
M.D.312 (Dassault) .. *(1954-55)* 137
M.D.315 Flamant (Dassault) *(1954-55)* 137
M.D.316 (Dassault) .. *(1953-54)* 133
M.D.450 Ouragan (Dassault) *(1957-58)* 147
M.D.451 (Dassault) .. *(1952-53)* 115
M.D.452 Mystere (Dassault) *(1957-58)* 146
M.D.453 (Dassault) .. *(1953-54)* 133
M.D.550 (Dassault) .. *(1956-57)* 133
M.d.B. (see Mariode Bernardi) .. 193
M.D.G. (see Instruments de Précision M.D.G.) .. .. *1951-52)* 130c
MEG-1x (Gluhareff) 305
MEG-2x (Gluhareff) 305
MEG-3x (Gluhareff) 305
M.F.1 Passaro .. .. *(1949-50)* 149c
M.F.2 Bipassaro .. *(1949-50)* 149c
M.H.52 (Max Holste) .. *(1951-52)* 131c
M.H.53 (Max Holste) .. *(1951-52)* 131c
M.H.250 Super Broussard (Max Holste) 158
M.H.1521 Broussard (Max Holste) .. 158
M.H.1522 Broussard (Max Holste) .. 158
MIE Sokol .. .. *(1951-52)* 111c
M.H.152 (Max Holste) .. *(1952-53)* 122
MI-1 (Mil) 225

PAGE

MI-1U (Mil) .. .. *(1957-58)* 219
MI-3 (Mil) 225
MI-4 (Mil) 225
MI-6 (Mil) 226
MIG (Russia) 223
MIG-9 .. .. *(1951-52)* 174c
MIG-15 .. .. *(1957-58)* 217
MIG-15*bis* 225
MIG-15UTI 225
MIG-17 223
MIG-19 223
MIG-21 223
MIS-1 (Poland) .. .. *(1950-51)* 165c
M.J.2 Tempête (Jurca) 157
M.K.E.K. (see Makina Ve Kimya Endustrisi Kurumu) 248
ML-10 (Millet-Lagarde) .. *(1951-52)* 131c
MP. 214 (Plan) .. .. *(1956-57)* 145
MR-2 (I.A.R.814) (Hungary) .. 214
MR-2 (Rumania) .. *(1957-58)* 208
MS-7C Avitruc (Chase) .. *(1951-52)* 214c
MS-8 Avitruc (Chase) .. *(1953-54)* 213
MS-8-1 BLC Pantobase (Stroukoff) .. 377
M.S. 474 (Morane-Saulnier) *(1951-52)* 132c
M.S. 475 (Morane-Saulnier) *(1951-52)* 132c
M.S. 477 (Morane-Saulnier) *(1952-53)* 122
M.S. 479 (Morane-Saulnier) *(1952-53)* 123
M.S. 571 (Morane-Saulnier) *(1948)* 146c
M.S. 700 (Morane-Saulnier) *(1952-53)* 123
M.S. 701 (Morane-Saulnier) *(1952-53)* 123
M.S. 703 (Morane-Saulnier) *(1952-53)* 123
M.S. 704 (Morane-Saulnier) *(1952-53)* 123
M.S. 708 (Morane-Saulnier) *(1952-53)* 123
M.S. 730 (Morane-Saulnier) *(1953-54)* 143
M.S. 731 (Morane-Saulnier) *(1953-54)* 144
M.S. 732 (Morane-Saulnier) *(1953-54)* 144
M.S. 733 (Morane-Saulnier) *(1956-57)* 146
M.S. 735 (Morane-Saulnier) *(1956-57)* 146
M.S. 755 (Morane-Saulnier) *(1956-57)* 145
M.S. 760 Paris (Morane-Saulnier) .. 159
M.S. 1500 Epervier (Morane-Saulnier) 159
MV-1 Starflight (Monsted-Vincent) *(1949-50)* 256c
M.L. AVIATION CO., LTD. (G.B.) .. 93
Mace (Martin) 420
Mach-Trainer (Fokker) 199
MACCHI S.A. AERONAUTICA (Italy) .. .. *(1957-58)* 186
McCULLOCH MOTORS CORPORATION (U.S.A.) .. *(1954-55)* 268
McDONNELL AIRCRAFT CORPORATION (U.S.A.) 337
McKINNIE AIRCRAFT COMPANY (U.S.A.) 340
McKINNON ENTERPRISES (U.S.A.) 340
Madge (Beriev) 219
MAESTRANZA CENTRAL DE AVIACION (Cjile) .. *(1956-57)* 120
Magister (Fouga).. 152
Magister Marine (Fouga) .. *(1957-58)* 151
Magnet (Yakovlev) .. *(1955-56)* 194
Major (Phoenix) 96
Makalu (Fouga) .. *(1957-58)* 151
MAKINA VE KIMYA ENDUSTRISI KURUMU (Turkey) 248
Mallard G.73 (Grumman) .. *(1951-52)* 246c
Mantis (Gail) 304
Marathon 1 (Handley Page) *(1955-56)* 84
Marathon 2 (Handley Page) *(1952-53)* 69
Mariner (Martin) .. *(1950-51)* 259c
MARIO DE BERNARDI (Italy) .. 193
Marksman (On Mark) .. *(1957-58)* 346
Marlin (Martin) 344
MARQUARDT AIRCRAFT COMPANY (U.S.A.) .. *(1951-52)* 262c
Marreco (I.P.T.) .. *(1951-52)* 14c
Mars (Breguet) .. .. *(1951-52)* 119c
Mars JRM-1 (Martin) .. *(1951-52)* 267c
Mars JRM-2 (Martin) .. *(1951-52)* 267c
MARTIN COMPANY, THE (U.S.A.) 341
MARTIN (see Glenn L. Martin Co.) *(1957-58)* 313
MARTIN-BAKER AIRCRAFT CO., LTD. (G.B.) .. .. *(1954-55)* 87
Martinet N.C. 702 (S.N.C.A.C.) *(1949-50)* 112c
Mascot (Ilyushin) 220
Matador (Martin) .. *(1957-58)* 335
Matajur (Yugoslavia) 390
Matajur-Trised (Yugoslavia) .. 390
MATRA-CANTINIEAU (France) *(1953-54)* 142
MATVIEYEV, Prof. (Soviet Union) .. 222
Mauler AM-1 (Martin) .. *(1951-52)* 266c
Max (Yakovlev) 232
MAX HOLSTE SOCIÉTÉ DES AVIONS (France) 158
MAX PLAN (France) .. *(1957-58)* 156
Maya (Philippine) .. *(1956-57)* 192
Méditerranée (Dassault) 148
Meise (East Germany) 183
Mentor (Beechcraft) 255
Mentor (Fuji) .. .. *(1956-57)* 182
Mercator P4M-1 (Martin) .. *(1951-52)* 263c



AVON SABRE

BRITANNIA SERIES 100, 250 & 300

COMET I, II & IV

CONVAIR 440

DOUGLAS DC7

GANNET

HELICOPTERS

HERCULES (C130)

JAVELIN

SABRE Mk II, V & VI

STRATOCRUISER

SUPER CONSTELLATION L1049

TRACKER (CS2F)

VALIANT

VANGUARD

VICTOR

VISCOUNT SERIES 803, 813 & 814

for all these types

we have delivered or are producing flight simulators for conversion and aircrew training.

Redifon

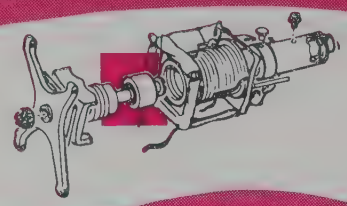
FLIGHT SIMULATOR DIVISION

REDIFON LTD · GATWICK ROAD · CRAWLEY, SUSSEX

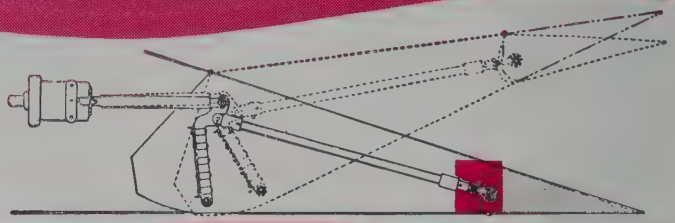
A Manufacturing Company in the Rediffusion Group

78R

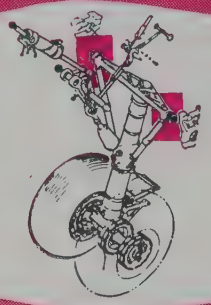
SHAFER® BEARINGS CARRY THE LOAD



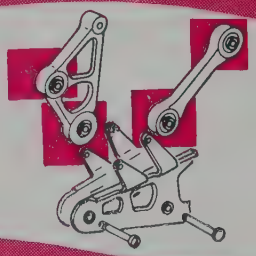
Elevator flight controls



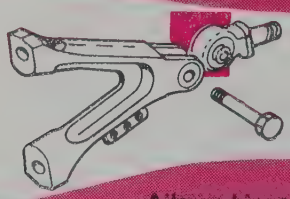
Aileron trim and servo tab control system



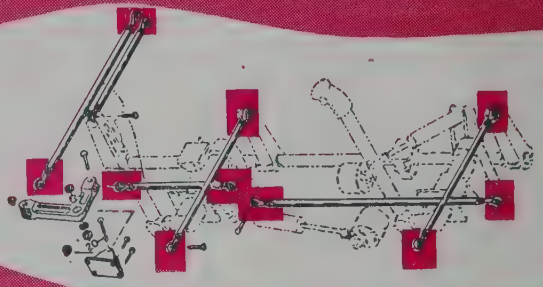
Main landing gear fulcrum and linkage



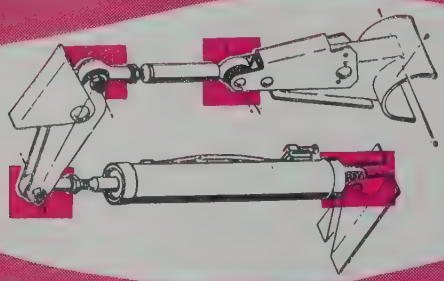
Wing flap hinge and linkage



Aileron hinge



Helicopter flight control group



Hydraulic actuator linkage



Helicopter blade pitch control link

Wherever design criteria call for greatest load-carrying capacity... smallest envelope dimensions and weight...Shafer Self-Aligning Anti-friction Bearings are specified today! Shafer Bearing Division, CHAIN Belt Company, Downers Grove, Ill. U.S.A.

SHAFER® AIRCRAFT BEARINGS

CHAIN BELT COMPANY

PAGE

Merchantman (Miles) .. *(1948)* 78c
Mercure (Breguet) .. *(1951-52)* 118c
Mercurey (Boisavia) 142
Merganser (Percival) .. *(1948)* 84c
Messenger (Miles) .. *(1948)* 81c
MESSERSCHMITT A.G. (Germany) 177
Meta-Sokol (Czechoslovakia) .. 134
Meteor (Armstrong Whitworth) *(1956-57)* 44
Meteor (Gloster) .. .. *(1956-57)* 76
Meteor (Monocoupe) .. *(1956-57)* 317
METEOR s.p.a. COSTRUZIONI AERONAUTICHE (Italy) .. 194
Meteor Trainer (Gloster) .. *(1951-52)* 58c
Meteor T.T. Mk. 20 (Armstrong Whitworth) 52
Metropolitan (Convair) 285
MEYER AIRCRAFT (U.S.A.) .. 345
MEYERS AIRCRAFT COMPANY (U.S.A.) .. .. *(1951-52)* 269c
Midge (Folland) .. .. *(1955-56)* 77
Midget (MIG) 225
Midget Mustang (Schweizer) *(1949-50)* 274c
Midgy Club (M.D.G.) .. *(1951-52)* 130c
Midjet (Fouga) .. .. *(1953-54)* 135
MIG (Russia) 223
Mighty Mite (Thompson) 381
MIGNET (see AVIOES MIGNET DO BRASIL) .. .. *(1953-54)* 43
MIL. MIKHAIL L (Soviet Union) .. 225
MIKOYAN, ARTEM (Soviet Union) 223
MIKOYAM & GUREVICH (MIG) (Russia) .. .. *(1955-56)* 191
MILES, F. G., LTD. (G.B.) .. 94
Military Consul (Airspeed) .. *(1950-51)* 17c
MILLETT LAGARDE SOCIETE (France) .. .. *(1951-52)* 131c
Milutinovic (Yugoslavia) .. *(1952-53)* 247
Minicab (C.A.B.) .. *(1956-57)* 132
MINIÉ AERONAUTIQUE, ETABLISSEMENTS VICTOR (France) *(1953-54)* 142
Minijet (SIPA) .. .. *(1956-57)* 158
Minor (Phoenix) 96
Mirage (Dassault) 148
Mis 1 (Poland) .. .. *(1951-52)* 168c
Mistrel (Sud-Est) .. *(1953-54)* 152c
Mitchell (North American) .. *(1950-51)* 268
Mite (Mooney) .. .. *(1956-57)* 317
MITSUBISHI JUKOGYO K.K. (Japan) 201
Model One (Aerocar) 252
Model 2 (Transcendental) .. *(1957-58)* 369
Model 3 (M.K.E.K.) 248
Model 4 Ugur (M.K.E.K.) 248
Model 5 (M.K.E.K.) 248
Model 6 (M.K.E.K.) 248
Model 7EC Traveler (Champion) .. 277
Model 7FC Tri-Traveler (Champion) .. 277
Model 8F (Silvaire) 375
Model II Aero-Plane (Aerocar) .. 252
Model 14-19-2 (Northern) .. *(1957-58)* 343
Model 15-AT (Hayden) .. *(1957-58)* 306
Model 16 (Doak) 290
Model 20 Zephyr (Taylorcraft) .. 378
Model 20AG (Taylorcraft) 379
Model 42A (Vertol Canada) .. 130
Model 42 (Vertol) 384
Model 44 (Vertol) 384
Model 45 Mentor (Beechcraft) .. 255
Model 47 (Agusta-Bell) .. *(1957-58)* 183
Model 47G (Bell) 259
Model 47H (Bell) .. *(1957-58)* 251
Model 47H-1 Bellairus (Bell) .. 261
Model 47J Ranger (Bell) 261
Model 51 (Temco) 379
Model 59-K (Piasecki) 359
Model 61 (Bell) 262
Model 73 Jet Mentor (Beechcraft) .. 256
Model 75 (Potez) .. .. *(1957-58)* 163
Model 76 (Vertol) 385
Model 82 (McDonnell) .. *(1957-58)* 331
Model 86 (McDonnell) .. *(1957-58)* 331
Model 92 Vertiplane (Ryan) .. 367
Model 95 Travel Air (Beechcraft) .. 254
Model 102 (Agusta-Bell) 189
Model 105 (Vertol) 385
Model 107 (Vertol) 385
Model 120 (Fawcett) .. *(1957-58)* 117
Model 150 (Cessna) 275
Model 159 Gulfstream (Grumman) *(1957-58)* 299
Model 165 (McKinnie) .. *(1957-58)* 331
Model 172 (Cessna) 275
Model 175 (Cessna) 275
Model 180 (Cessna) 275
Model 182 (Cessna) 276
Model 200 (Bell) 259
Model 202 Mantis (Gail) 304
Model 204 (Bell) 259
Model 212 (Bell) .. *(1957-58)* 249
Model 237 (Martin) 344
Model 240 (Convair) 287
Model 269 (Hughes) 318
Model 272 (Martin) 341
Model 275 Sea Master (Martin) .. 342

PAGE

Model 310 (Cessna) 274
Model 318 (Cessna) 272
Model 321 (Cessna) 274
Model 340 (Convair) 287
Model 440 Metropolitan (Convair) *(1957-58)* 277
Model 450 Marksman (On Mark) *(1957-58)* 344
Model 600 (Convair) 285
Model 600 (Kaman) 320
Model 620 (Cessna) .. *(1957-58)* 263
Model 674 Valiant (Vickers) *(1957-58)* 104
Model 680 Super (Aero) .. *(1957-58)* 241
Model 707 Stratoliner (Boeing) .. 264
Model 717 (Boeing) .. *(1957-58)* 257
Model 880 (Convair) .. *(1957-58)* 276
Model 1000 (Clark) 280
Model 1001 (Beechcraft) 257
Model 1013 (Beechcraft) 258
Model 1049 Super Constellation (Lockheed) .. .. *(1957-58)* 319
Model 1405 Gerfout II (Nord) .. 160
Model 1500 Griffon (Nord) .. 160
Model 1649A Starliner (Lockheed) .. *(1957-58)* 322
Model 2501-2508 Noratlas (Nord) .. 161
Model 3202 (Nord) 161
Model 3400 (Nord) 161
Model 7002 (Fiat) 192
Model S (Auster) .. *(1953-54)* 46
Mohawk (Grumman) 307
Mojave (Sikorsky) 372
MOLYNEUX HELICOPTER CO., PTY., LTD. (Australia) .. 120
Monitor (Farman) .. *(1957-58)* 149
Monitor (Neiva) .. .. *(1957-58)* 47
Monitor IV (Stampe-Renard) *(1957-58)* 45
MONOCOUPE AIRCRAFT OF FLORIDA, INC. (U.S.A.) *(1956-57)* 317
MOONEY AIRCRAFT INC. (U.S.A.) .. 345
Mooney Mark 20 345
Mooney Mark 20A 346
Mooney Mark 22 345
Moose (Yakovlev) 233
MORANE-SAULNIER, AÉROPLANES (France) 158
Morava (Czechoslovakia) 136
MORIN, PIERRE (France) *(1953-54)* 144
Moskva (Ilyushin) .. *(1957-58)* 214
Mosquito (D.H.) .. *(1949-50)* 49c
MOTOKOV LTD. (Czechoslovakia) *(1955-56)* 125
Motor-Möwe (Dittmar) .. *(1956-57)* 163
Motor-Pilis (Hungary) 184
Motorraab (Putzer) 177
Motor Tutor (Slingsby) .. *(1952-53)* 80
Mousquetaire (Nord) 164
MÖWE-FLUGZEUGBAU HEINI DITTMAR (Germany) 175
Mraz (Czechoslovakia) .. *(1949-50)* 104c
Mucha 100 (Poland) 206
Multoplane (RW) 178
MUNIZ, Cassio, S.A. (Brazil) (see OMAREAL) .. .. *(1956-57)* 43
Musang (Philippines) 207
Musca 1 (Muscariello) .. *(1953-54)* 163
MUSCARIELLO Ing. F. (Italy) *(1953-54)* 163
MV-1 Starflight (Monsted-Vincent) *(1949-50)* 256c
Mystere II (Dassault) .. *(1957-58)* 146
Mystere IV A (Dassault) 150
Mystere IV B (Dassault) .. *(1957-58)* 146
Mystere IV N (Dassault) .. *(1956-57)* 135
MYASISHCHEV, V.M. (Soviet Union) 226

N

N/76 (Hawker) .. .. *(1949-50)* 63c
N.20 (Federale) .. *(1952-53)* 167
N.52 (Okamura) .. .. *(1956-57)* 134
N.113 (Supermarine) .. *(1957-58)* 102
N-156F (Northrop) 356
NA.39 (Blackburn) 59
NA-75 (National) 346
N.A.141 (North American) Fury *(1948)* 300c
N.A.142 (North American) .. *(1949-50)* 262c
N.A.147 (North American) .. *(1948)* 301c
N.A.159 (North American) .. *(1952-53)* 233
N.A.160 (North American) .. *(1949-50)* 260c
NAA-249 (North American) .. 353
N.C.211 Cormoran (S.N.A.C.) *(1949-50)* 110c
N.C.270 (S.N.C.A.C.) .. *(1949-50)* 110c
N.C.271 (S.N.C.A.C.) .. *(1949-50)* 110c

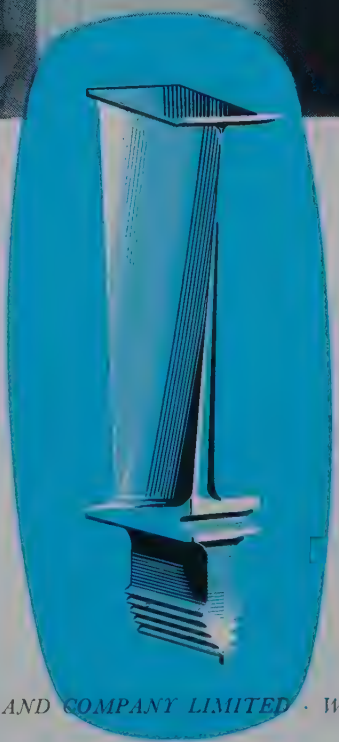
PAGE

N.C.702 Martinet (S.N.C.A.C.) *(1949-50)* 112c
N.C.850 Club .. .. *(1948)* 134c
N.C.854 (S.N.C.A.C.) .. *(1949-50)* 112c
N.C.856 (Nord) .. *(1956-57)* 149, 150
N.C.860 (S.N.C.A.C.) .. *(1949-50)* 113c
N.C.1071 (S.N.C.A.C.) .. *(1949-50)* 111c
N.C.1072 (S.N.C.A.C.) .. *(1949-50)* 111c
N.C.1080 (Nord) .. .. *(1950-51)* 134c
N.C.2001 Abeille (S.N.C.A.C.) *(1949-50)* 113c
N.C.2002 (S.N.C.A.C.) .. *(1949-50)* 113c
N.C.3020 Belphegor (N.S.C.A.C.) *(1949-50)* 113c
N.F.11 (Armstrong Whitworth *(1952-53)* 34
NHI (see Nederlandse Helicopter Industrie N.V.) 206
NH-160 (Nagler) 346
NIK2-J George (Kawanishi) *(1945-46)* 160c
NRK (Antonov) 216
NU-25 Kunang (Indonesia) .. 185
NU-85 Belalang (Indonesia) .. 186
NU-200 (Indonesia) .. *(1956-57)* 169
NU-225 Sikumbang (Indonesia) .. 185
Nu.D.36 (Nuri Demirag) .. *(1949-50)* 183c
NAGLER HELICOPTER COMPANY INC. (U.S.A.) 346
Nancu (Instituto Aerotecnico) *(1951-52)* 7c
NARDI S.A. PER COSTRUZIONI AERONAUTICHE (Italy) .. 196
Narvel (Sud-Ouest) .. *(1949-50)* 137c
NATIONAL AIRCRAFT DIVISION OF AMERICAN AIRMOTIVE CORPN. (U.S.A.) 346
Navion (Ryan) .. *(1952-53)* 242
NEDERLANDSE HELICOPTER IND. N.V. 206
NEIVA (see SOC. CONSTRUTORA AERONAUTICA NEIVA. LTDA (Brazil) 48
Nene-Viking (Vickers) .. *(1950-51)* 94c
Neptune (Lockheed) 335
Newbury Eon (Elliotts) .. *(1950-51)* 54
Nibbio (Aviamilano) 189
Nietoperz (Poland) .. *(1953-54)* 174
Nifty (Morrisey) .. *(1950-51)* 261c
Nikko (Fuji) 201
Nimbus (Short) .. .. *(1948)* 97c
Nipper (Avions Fairey) 46
Noralpha (Nord) .. .. *(1948)* 147c
Noratlas (Nord) 161
Norazur (Nord) .. .. *(1949-50)* 127c
NORD (see Société Nationale de Constructions Aeronautiques du Nord) .. 160
NORD-AVIATION, SOCIÉTÉ NATIONAL DE CONSTRUCTIONS AÉRONAUTIQUES (France) .. 160
Nord 1101 .. .. *(1948)* 147c
Nord 1201 .. .. *(1948)* 148c
Nord 1203/II Norécrin II .. *(1951-52)* 134c
Nord 1221 Norelana .. *(1949-50)* 125c
Nord 1226 .. .. *(1956-57)* 149
Nord 1300 .. .. *(1948)* 151c
Nord 1400 .. .. *(1951-52)* 135c
Nord 1402 .. .. *(1957-58)* 158
Nord 1405 .. .. *(1957-58)* 159
Nord 1500 Noréclair .. *(1949-50)* 126c
Nord 1500 Griffon .. *(1957-58)* 158
Nord 1600 .. .. *(1948)* 149c
Nord 1601 .. .. *(1951-52)* 136c
Nord 1700 .. .. *(1948)* 149c
Nord 1750 Norelfe .. *(1955-56)* 154
Nord 2000 .. .. *(1948)* 150c
Nord 2100 Norazur .. *(1949-50)* 127c
Nord 2200 .. .. *(1951-52)* 137c
Nord 2500 .. .. *(1951-52)* 137c
Nord 2501 161
Nord 2502 162
Nord 2504 162
Nord 2506 162
Nord 2507 162
Nord 2508 162
Nord 3200 .. .. *(1956-57)* 148
Nord 3201 .. .. *(1956-57)* 148
Nord 3202 161
Nord 3400 161
Noréclair (Nord) .. *(1949-50)* 126c
Norécrin (Nord) .. .. *(1951-52)* 134c
Norelan (Nord) .. .. *(1949-50)* 125c
Norelfe (Nord) .. .. *(1955-56)* 154
NORMANDE, SOCIETE AERONAUTIQUE (France) 164
Noroit (Nord) .. .. *(1954-55)* 148
Norseman (C.C.F.) .. *(1950-51)* 101c
NORSK FLYINDUSTRI A/S (Norway) .. .. *(1955-56)* 184
NORTH AMERICAN AVIATION, INC. (U.S.A.) 347
NORTHERN AIRCRAFT INC. (U.S.A.) 355
NORTHROP AIRCRAFT, INC. (U.S.A.) 355
Norvigie (Nord) .. .. *(1956-57)* 149

TESTING TIME FOR METALS

Development testing of a Rolls-Royce Tyne engine.

Progress in turbine engines calls for ever higher operating temperatures and creates incessant demands for more advanced heat-resisting materials. These demands are being met in every British aero gas turbine by the Nimonic Series of Alloys which retain great strength even at red heat. In the Tyne turbo-prop, which is to power the new Vickers Vanguard airliner fleet, Nimonic Alloys are specified for the turbine rotor blading and many other parts in contact with the hot gases.



NIMONIC

'NIMONIC' IS A REGISTERED TRADE MARK

ALLOYS

USED IN EVERY BRITISH AERO GAS TURBINE

HENRY WIGGIN AND COMPANY LIMITED · WIGGIN STREET · BIRMINGHAM 16

TGA HTA25

PAGE

NURI DEMIRAG TAYYARE FABRIKASI (Turkey) .. (1952-53) 168
Nymphale (Breguet) 147

O

O.1 (Morin) .. .. (1953-54) 144
O.10 (Leduc) .. .. (1955-56) 146
O.21 (Leduc) .. .. (1957-58) 154
O.22 (Leduc) .. .. (1957-58) 155
O.101 (Arsenal) .. .. (1949-50) 114c
OE-1 (Cessna) 273
OE-2 (Cessna) 274
OF-1 (Grumman) .. (1957-58) 300
OFW (see OSTERREICHISCHE FLUGZEUGWERK) 46
OK-15 (OFW) 46
OKA 32 (Antonov) .. (1951-52) 170c
OQ-19 and KD2R (Radioplane) .. 362
OTW-160 (Meyers) (1949-50) 255c
OAKLAND AIRMOTIVE (U.S.A.) .. 357
Observer (Luscombe) .. (1949-50) 244c
OFICINA DE MANUTENCÃO E RECUPERACÃO DE AVIOES, LTDA (Brazil) 49
OFICINAS GERAIS DE MATERIAL AERONAUTICO (Portugal) (1957-58) 208
OKAMURA SEISAKUJO K.K. (Japan) .. .. (1956-57) 184
Olympia (Elliotts) 73
Olympia Eon (Elliotts) .. (1950-51) 54c
OMAREAL (Brazil) (see OFICINA DE MANUTENCÃO E RECUPERACÃO DE AVIOES, LTDA) 49
Omega Development (Bratukhin) (1951-52) 170c
OMEGA AIRCRAFT CORPORATION (U.S.A.) 358
ON MARK ENGINEERING CO. (U.S.A.) 358
Orao (Yugoslavia) .. (1952-53) 248
OSRODEK KONSTRUKCJI LOTNICZYCH (Poland) .. 208
OSTERREICHISCHE FLUGZEUGWERK G.m.b.H. (Austria) 46
Otter DHC-3 (D.H. Canada) .. 128
Ouragan (Dassault) .. (1957-58) 147
OUEST-AVIATION, SOCIÉTÉ NATIONALE DE CONSTRUCTIONS AERONAUTIQUES (France) (1956-57) 152

P

P-1 (English Electric) 73
P.1 Target Drone (Meteor) .. 194
P.2 (Pilatus) .. .. (1951-52) 190c
P2B-1 (Boeing) .. (1951-52) 208c
P2V Neptune (Lockheed) .. 335
P-3 (Pilatus) 247
P.4 (Pilatus) .. .. (1951-52) 190c
P4M-1 Mercator (Martin) .. (1951-52) 263c
P5M Marlin (Martin) 344
P6M Sea Master (Martin) 342
P.11 (English Electric) 75
P-16 (FFA) .. .. (1956-57) 222
P.18 (Ambrosini) .. (1957-58) 183
P.40 Prentice (Percival) .. (1951-52) 70c
P.44 Proctor 5 (Percival) .. (1949-50) 70c
P.47 Proctor 6 (Percival) .. (1949-50) 71c
P.50 Prince III (Hunting Percival) (1955-56) 88
P-53 Aeroscooter (Partenavia) (1957-58) 189
P.54 Survey Prince IIIA (Hunting Percival) .. .. (1955-56) 89
P-55 Tornado (Partenavia) .. 197
P.56 Provost (Hunting) 90
P-57 Fachiro (Partenavia) 197
P.57 Sea Prince (Hunting Percival) (1956-57) 85
P.66 Pembroke (Hunting) .. 91
P.74 (Hunting Percival) .. (1955-56) 86
P.84 Jet Provost (Hunting) (1957-58) 89
P.85 Jet Provost (Hunting Percival) (1957-58) 87
P.108 Balliol (Boulton Paul) (1955-56) 57
P.110 (C.V.V.) .. .. (1951-52) 154c
P.111 (Boulton Paul) .. (1955-56) 58
P.120 (Boulton Paul) .. (1953-54) 54
P.136 (Piaggio) .. (1957-58) 191
P.136L-1 and L-2 (Piaggio) .. 199
P.148 (Piaggio) .. (1957-58) 191
P.149 (Piaggio) .. .. (1956-57) 179
P.149-D (Piaggio) 198
P.150 (Piaggio) .. .. (1956-57) 179
P-155 (Piaggio) 198
P-166 (Piaggio) 197
P-177 (Saunders-Roe) .. (1957-58) 96
P.512 (Ambrosini) .. (1950-51) 148c
P.531 (Saunders-Roe) 97
P.1040 (Hawker) .. (1949-50) 63c
P.1052 (Hawker) .. (1953-54) 82
P.1072 (Hawker) .. (1952-53) 70
P.1081 (Hawker) .. (1951-52) 64c
P.1121 (Hawker) 87
P-1604 (FFA) .. .. (1956-57) 238
Pa.60 Arbalète (Payen) 164
PA-11 Trainer (Piper) .. (1949-50) 268c
PA-12 (Piper) .. .. (1948) 310c
PA-14 Family Cruiser (Piper) (1949-50) 268c
PA-15 (Piper) .. .. (1949-50) 268c
PA-16 Clipper (Piper) .. (1949-50) 269c
PA-17 Vagabond (Piper) (1949-50) 269c
PA-18 Super Cub "95" (Piper) .. 361
PA-18 Super Cub "150" (Piper) .. 361
PA-18-A (Piper) 361
PA-19 Super Cub (Piper) .. (1951-52) 282c
PA-20 Pacer (Piper) .. (1954-55) 286
PA-22 Tri-Pacer (Piper) 360
PA-23 Apache (Piper) 360
PA-24 Comanche (Piper) 360
PA.49/B (Payen) .. (1957-58) 162
PA-204 Super Cigale (Aubert) .. 142
PA 300 (Aubert) .. .. (1954-55) 129
PBM Mariner (Martin) .. (1950-51) 259c
P.D.11 (Short) .. .. (1956-57) 90
PD-18 (Piasecki) .. (1955-56) 301
PD-22 (Piasecki) .. (1955-56) 302
PE-2 (Petlyakov) .. (1951-52) 174c
PE-8 (Petlyakov) .. (1949-50) 166c
PF.204 (Max Plan) .. (1955-56) 148
PL.5C (Aerauto) .. .. (1952-53) 136
PL-7 Tanker (Kingsford Smith) (1957-58) 117
P.M.280 Tartuca (C.V.V.) .. (1951-52) 154c
PO-1W Constellation (Lockheed) (1951-52) 252c
PO-2 (Polikarpov) .. (1953-54) 179
PO-2W Constellation (Lockheed) (1951-52) 252c
PS-84 (Russian DC-3) .. (1948) 195c
PTV-N-2 (Martin) .. (1949-50) 254c
PV-3 Rescuer (Piasecki) .. (1955-56) 302
PV-14 Retriever (Piasecki) .. (1951-52) 280c
PV-15 Transporter (Piasecki) (1955-56) 302
PV-17 (Piasecki) .. (1955-56) 302
P.Z.L. S.1 (Poland) .. (1951-52) 168c
PZL-101 (Poland) 209
PZL-102 Kos (Poland) 208
PACAERO ENGINEERING CORPN. (U.S.A.) 322
Pacer (Piper) .. .. (1954-55) 286
Pack Plane (Fairchild) .. (1951-52) 236c
Packet (Fairchild) 294
Pajtás (Hungary) .. (1956-57) 168
Panther (Grumman) .. (1955-56) 263
Pantobase (Stroukoff) 377
Parasite (McDonnell) .. (1948) 286c
Paris (Morane-Saulnier) 159
Paris-Nice (Wassmer) 173
Parrakeet (Hannaford) .. (1949-50) 223c
PARTENAVIA CONSTRUZIONI AERONAUTICHE (Italy) .. 197
PASOTTI s.p.a., LEGNAMI (Italy) (1957-58) 190
Passaro (Movo) .. .. (1949-50) 149c
Paulistinha-56 (Neiva) 48
Paulistinha 56-B (Neiva) 48
Paulistinha 56-C (Neiva) 48
Paulistinha (Companhia Aeronautica Paulista) .. .. (1948) 13c
PAUL LEGRAN (France) .. 157
Pawnee (Hiller) 317
PAYEN AVIATION (France) .. 64
Pchelka (Antonov) 218
Pedro (G.C.A.) .. .. (1951-52) 157c
Pégase (Sud-Ouest) .. (1950-51) 144c
Pegaz (Poland) .. .. (1951-52) 168c
Pelican (Doman) .. .. (1951-52) 223c
Pembroke (Hunting) 91
Peque (AISA) .. .. (1955-56) 198
PERCIVAL AIRCRAFT LTD. (G.B.) (see Hunting Percival) .. (1954-55) 83
PERCIVAL, EDGAR AIRCRAFT LTD. (G.B.) .. .. (1956-57) 66
PETLYAKOV, VLADIMIR (Russia) .. .. (1952-53) 155
PETROLINI HERMANOS. SOC. ANON IND. Y COM. (Argentine Republic) .. .. (1951-52) 10c
Phantom (McDonnell) (1950-51) 252c
PHOENIX AIRCRAFT LTD. (G.B.) 96
Phrygane (C.F.A.) .. (1953-54) 131
Phryganet (C.F.A.) .. (1951-52) 122c
PIAGGIO & C. SOCIETA PER AZIONI (Italy) 197
PIASECKI HELICOPTER CORPORATION (U.S.A.) (see *VERTOL AIRCRAFT CORP.*) .. (1955-56) 300
PIASECKI AIRCRAFT CORP. (U.S.A.) 359
PIEL AVIATION (France) .. 165
PIK (see Polyteknikkojen Ilmailukerho) (Finland) 139
PIK-3C 139
PIK-11 .. .. (1957-58) 135
PIK-12 .. .. (1957-58) 136
PIK 13 .. .. (1955-56) 129
Pika (Australia) .. .. (1956-57) 106
PILATUS FLUGZEUGWERKE A.G. (Switzerland) 247
Pinto (Temco) .. .. (1957-58) 367
Pinty (Aero-Ever) .. (1951-52) 149c
Pinwheel (Rotor-Craft) 367
Pioneer (Northrop) .. (1948) 307c
Pioneer (Scottish Aviation) .. (1957-58) 97
Pionir (Yugoslavia) .. (1955-56) 321
PIPER AIRCRAFT CORPORATION (U.S.A.) 359
Piper-Stinson (Piper) .. (1949-50) 269c
Pirate F6U-1 (Chance Vought) (1950-51) 213c
PLAN, MAX (France) .. (1955-56) 148
PLANADORES NEIVA (Brazil) (1953-54) 43
Planalto (I.P.T.) .. (1951-52) 12c
Playboy (Stits) 376
Plebe (Temco) .. .. (1954-55) 296
Pjiszka (Poland) 209
Plover (Martin) .. .. (1952-53) 229
Polar (Wideroe) .. .. (1952-53) 147
POLIKARPOV, NIKOLAI N. (Russia) (1953-54) 179
POLYTEKNIKKOJEN ILMAILUKERHO (Finland) 139
Portsmouth Aerocar .. (1948) 86c
Potez 75 (Potez) .. (1955-56) 156
POTEZ AIR-FOUGA (France) .. 152
POTEZ ETABLISSEMENTS HENRI (France) 165
Praga (Czechoslovakia) .. (1948) 126c
Praga E-55 (Czechoslovakia) (1956-57) 121
Prefect (Slingsby) .. (1957-58) 101
Prentice (Percival) .. (1951-52) 70c
President (Hunting) .. (1957-58) 90
Prestwick Pioneer (Scottish Aviation) (1957-58) 98
Prestwick Twin Pioneer (Scottish Aviation) 100
Primary Eon (Elliotts) .. (1950-51) 55c
Primer (Fairey) .. .. (1950-51) 59c
Prince III (Hunting Percival) (1955-56) 88
Princess (Saunders-Roe) .. (1955-56) 92
Proctor 5 (Percival) .. (1949-50) 70c
Proctor 6 (Percival) .. (1949-50) 71c
Promotor (Fokker) .. (1949-50) 154c
Prone Pilot Meteor 8 .. (1957-58) 45
Prospector (Cub Aircraft) .. (1949-50) 99c
Provence (Breguet) .. (1951-52) 119c
Provider (Fairchild) 302
Provost (Hunting) 90
Pulqui I (Instituto Aerotecnico) (1951-52) 8c
Pulqui II (I. A.) .. (1956-57) 40
PUTZER, ALFONS, KG (Germany) .. 177

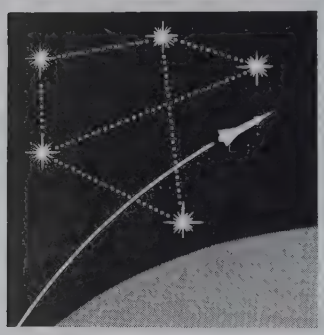
Q

Q-2 Firebee (Ryan) 368
Q-5 (Lockheed) 337
QR.14 (Marinavia) .. (1948) 170c

R

R.1 (Rey) .. .. (1952-53) 126
R3Y Tradewind (Convair) .. (1957-58) 273
R4D (Douglas) .. .. (1952-53) 205
R4D 8 (Douglas) .. (1951-52) 232c
R4Q Packet (Fairchild) .. (1957-58) 294
R4Y (Convair) 289
R5D (Douglas) 277
R6D-1 (Douglas) 300
R.7V (Lockheed) 328
R.10 Kanya (Aero-Ever) .. (1951-52) 149c
R.14 Pinty (Aero-Ever) .. (1951-52) 149c
R-15A (Northrop) .. (1948) 308c
R-15f Koma (Hungary) 184
R.18 (Hungary) .. .. (1956-57) 168
R-23 Gebics (Hungary) 184
R-52 (Tachikawa) .. (1953-54) 168
R-53 (Tachikawa) 202
R.60-1 Constitution (Lockheed) (1950-51) 245c
R.70-1 Constellation (Lockheed) (1951-52) 252c
R.A.14 Loisirs (Adam) .. (1956-57) 127
R.A.17 (Adam) .. .. (1951-52) 116c
RB-66 (Douglas) 295
RC-121 (Lockheed) .. (1957-58) 319
RC-131 (Convair) .. (1957-58) 280
RF-84F (Republic) .. (1957-58) 354
RF-84K (Republic) .. (1957-58) 332





30 YEARS OF EXPERIENCE

In producing...

- AIRCRAFT ENGINE AND FLIGHT INSTRUMENTS
- MISSILE COMPONENTS AND SYSTEMS
- AIR DATA COMPUTERS AND ELECTROMECHANICAL SYSTEMS
- OPTICAL SYSTEMS AND COMPONENTS
- PRESSURE SENSITIVE CONTROLS FOR AIRCRAFT AND GUIDED MISSILES: Monitors, Switches, Transmitters, Pickups, Cabin Pressure Regulators
- KOLLSMAN INTEGRATED FLIGHT INSTRUMENT SYSTEM
- NAVIGATION DEVICES: Sextants (Periscopic—Handheld—Photoelectric), Astro Trackers, Automatic Astrocompass, Doppler Computation Systems
- MOTORS AND SYNCHROS
- INSTRUMENTS FOR SIMULATED FLIGHT TRAINERS
- TEST INSTRUMENTS FOR AERONAUTICAL AND INDUSTRIAL LABORATORIES



For a complete detailed list of Kollsman Products send for illustrated Product List.

kollsman INSTRUMENT CORPORATION

80-08 45th AVENUE, ELMHURST, NEW YORK • GLENDALE, CALIFORNIA

Subsidiary of *Standard* Coil Products Co. Inc.

PAGE

RF-101 (McDonnell) 337
RG-6 (Hungary) 215
RG-60 (S.E.C.A.T.) .. *(1948)* 153c
RG-75 (S.E.C.A.T.) .. *(1948)* 153c
RH-1 (Rotor-Craft) 367
RL-26D (Aero) .. .. *(1957-58)* 241
R-HM Shin (Tachikawa) .. *(1957-58)* 195
RM-1 (Martin) .. .. *(1953-54)* 255
RP-70 (Radioplane) 362
RP-71 (Radioplane) 363
RP-76 (Radioplane) 363
RP-77 (Radioplane) .. *(1957-58)* 351
RP-77D (Radioplane) 363
RS2L (Ross) .. .. *(1949-50)* 272c
RT-33 (Lockheed) 333
RW.3-A2 Multoplane (RFB) .. 179
RW.3-A3 Multoplane (RFB) .. 178
RWF (see RHEIN-WEST-FLUG FISCHER U COMPANIE) *(1957-58)* 175
RW.3 Multoplane (RWF) .. *(1957-58)* 175
RW.3-A2 (RWF) .. *(1957-58)* 175
RW.3-A3 (RWF) .. *(1957-58)* 175
RADIOPLANE CO. (U.S.A.) .. 362
RADIOPLANE DIVISION, NORTHROP AIRCRAFT, INC. (U.S.A.) .. 362
Raider C 125 (Northrop) .. *(1951-52)* 277c
Ram-Jet Helicopter (McDonnell) *(1952-53)* 266
Ranch Wagon (Taylorcraft) *(1957-58)* 366
Ranger (Bell) 261
Raven (Hiller) 316
RAWDON BROTHERS AIRCRAFT, INC. (U.S.A.) 363
REGENT AIRCRAFT, INC. (U.S.A.) *(1954-55)* 287
Regulus I (Chance Vought) *(1957-58)* 268
Regulus II (Chance Vought) *(1957-58)* 269
Reporter R-13A (Northrop) *(1948)* 308c
RÉPUBLIC AVIATION CORPORATION (U.S.A.) 364
Rescuer (Vertol) .. .. *(1956-57)* 345
Retriever (Vertol) 382
REY (see Société des Avions Francois Rey) .. .. *(1952-53)* 126
RFB (see Rhein-Flugzeugbau G.m.b.H.) 178
RHEIN-FLUGZEUGBAU G.m.b.H. (Germany) 178
RHEIN-WEST-FLUG FISCHER U. COMPANIE (Germany) *(1957-58)* 175
RIDDLE AIRLINES, INC. (U.S.A.) 366
RILEY AIRCRAFT COMPANY (U.S.A.) .. .. *(1953-54)* 272
Riley (Temco) .. .. *(1956-57)* 343
Riley Twin (Temco) .. *(1957-58)* 368
ROBERTSON DEVELOPMENT CORPORATION (U.S.A.) *(1954-55)* 290
Rocket (Regent) .. .. *(1954-55)* 287
ROE, A. V. & CO., LTD. (G.B.) .. 56
Roitelet (J.D.M.) .. *(1951-52)* 127c
ROLLASON AIRCRAFT & ENGINES LTD. (G.B.) 96
Rondone (Ambrosini) .. *(1957-58)* 184
Rossiya (Tupolev) 228
ROTOR-CRAFT CORP. (U.S.) .. 366
Rotorcycle (Gyrodyne) 312
Rotodyne (Fairey) 80
Royal Gull (Trecker) .. *(1957-58)* 370
Royal Gull Super 200 (Trecker) *(1957-58)* 370
RYAN AERONAUTICAL COMPANY (U.S.A.) 367

S

S-1B1 (Callair) .. .. *(1956-57)* 245
S-2 (Poland) 212
S2F Tracker (Grumman) 209
S-4 Kania 2 (Poland) 309
S.4A (Siebel) .. .. *(1953-54)* 273
S.5 (S.E.C.A.T.) .. *(1948)* 153c
S.7 *(Ambrosini)* .. .. *(1955-56)* 167
S.10 (S.I.P.A.) .. .. *(1949-50)* 129c
S.11 Instructor (Fokker) .. *(1956-57)* 189
S.12 Instructor (Fokker) .. *(1956-57)* 189
S.12 (S.I.P.A.) .. .. *(1954-55)* 153
S.13 (Fokker) .. .. *(1954-55)* 176
S.14 Mach-Trainer (Fokker) *(1957-58)* 199
S.18 (Saab) .. .. *(1951-52)* 187c
S.20 (S.I.P.A.) .. .. *(1948)* 154c
S.25 Sunderland (Short) .. *(1951-52)* 82c
S.25/V Sundringham (Short) *(1951-52)* 81c
S.28 (Slingsby) .. .. *(1948)* 97c
S.29 (Saab) 244
S.32 (Saab) 243
S.35 Shetland (Short) .. *(1949-50)* 79c
S.45A Solent (Short) .. *(1951-52)* 81c
S.49 (Ikarus) .. .. *(1954-55)* 300

PAGE

S-49C (Yugoslavia) 388
S.50 (SABCA) .. .. *(1949-50)* 10c
S.51 (Sikorsky) .. .. *(1954-55)* 292
S-51 (Westland) .. .. *(1955-56)* 105
S-52-2 (Sikorsky) .. .. *(1953-54)* 274
S-55 (Sikorsky) 374
S-55 (Westland) .. .. *(1955-56)* 107
S-56 (Sikorsky) 372
S-57 (Sikorsky) .. .. *(1956-57)* 337
S-58 (Sikorsky) 371
S-59 (Sikorsky) .. .. *(1956-57)* 338
S-61 (Sikorsky) 371
S-62 (Sikorsky) 371
S.70 (S.I.P.A.) .. .. *(1948)* 154c
S.90 (S.I.P.A.) .. .. *(1948)* 155c
S-103 (Czechoslovakia) 133
S.111 (S.I.P.A.) .. .. *(1951-52)* 140c
S.121 (S.I.P.A.) .. .. *(1954-55)* 153
S-451M (Yugoslavia) 387
S.901 (S.I.P.A.) .. .. *(1951-52)* 140c
S.1001 (Grifo Ambrosini) .. *(1951-52)* 152c
S.1002 Trasimenus (Ambrosini) *(1951-52)* 152c
S.A.1 Sturgeon (Short) .. *(1949-50)* 75c
S.A.2 Sturgeon (Short) .. *(1955-56)* 94
S.A.4 (Short) .. .. *(1953-54)* 91
SA-3A Playboy (Stits) 376
SA-3B (Stits) 376
S.A.6 Sealand (Short) .. *(1954-55)* 95
SA-6B Flut-R-Bug (Stits) 376
SA-7 Sky-Coupe (Stits) 376
SA-16 Albatross (Grumman) .. 311
S.A.103 (Arsenal) .. *(1948)* 137c
SAAB (see Svenska Aeroplan A.B.) (Sweden) 242
SABCA (see Société Anonyme Belge de Constructions Aéronautiques .. 47
S.A.C.A. (see Societa per Azioni Costruzioni Aeronavali) .. *(1951-52)* 161c
S.B.2 (Pilatus) .. .. *(1948)* 206c
S.B.3 (Short) .. .. *(1951-52)* 78c
S.B.4 Sherpa (Short) .. *(1955-56)* 96
S.B.5 (Short) 101
S.B.6 Seamew (Short) .. *(1956-57)* 90
S.B.9 Sturgeon (Short) .. *(1954-55)* 94
SC-1 and SC-2 (Curtiss) .. *(1948)* 243c
S.C.1 (Short) 101
S.C.A.N. (see Société de Constructions de Port-Neuf) .. .. *(1952-53)* 127
S.C.A.N. 20 (S.C.A.N.) .. *(1951-52)* 138c
S.C.A.N. 30 (S.C.A.N.) .. *(1951-52)* 138c
SD-3 (Republic) 366
S.E.116 (Sud) 169
S.E.120 (Sud-Est) .. *(1950-51)* 139c
S.E.161 Languedoc (Sud-Est) *(1951-52)* 143c
S.E.200 (Sud-Est) .. *(1948)* 156c
S.E.210 Caravelle (Sud) 167
S.E.212 Durandal (Sud) 168
S.E.1010 (Sud-Est) .. *(1949-50)* 131c
S.E.1200 (Sud-Est) .. *(1949-50)* 132c
S.E.1210 (Sud-Est) .. *(1949-50)* 132c
S.E.2010 Armagnac (Sud-Est) *(1953-54)* 151
S.E.2100 (Sud-Est) .. *(1948)* 159c
S.E.2300 (Sud-Est) .. *(1948)* 160c
S.E.2310 (Sud-Est) .. *(1948)* 161c
S.E.2410 Grognard (Sud-Est) *(1952-53)* 130
S.E.3000 Helicopter (Sud-Est) *(1949-50)* 134c
S.E.3101 Helicopter (Sud-Est) *(1950-51)* 140c
S.E.3110 Helicopter (Sud-Est) *(1950-51)* 140c
S.E.3120 (Sud-Est) .. *(1953-54)* 151
S.E.3130 (Sud) 171
S.E.3200 (Sud) 171
S.E.3140 (Sud) 172
S.E.4000 (Sud-Est) .. *(1949-50)* 134c
S.E.5000 Baroudeur (Sud) .. *(1957-58)* 167
S.E. X.116 Fonceur (Sud) .. *(1957-58)* 167
S.E.C.A.N. (see Société d'Etudes et de Constructions Aéro-Navales (1954-55) 151
S.E.V.I.M.I.A. (see Société Minie) Aviation) .. .. *(1952-53)* 127
SF-23 Sperling (Scheibe) .. *(1957-58)* 176
SF-23A Sperling (Scheibe) 179
S.F.E.C.M.A.S. (see Société Française d'Etudes et de Constructions de Matériels Aeronautique Speciaux) *(1955-56)* 150
SG-2 (Hungary) .. .. *(1956-57)* 168
SGS 1-21 (Schweizer) .. *(1950-51)* 279c
SGS 1-23D Sailplane (Schweizer) .. 370
SGS 1-26 Sailplane (Schweizer) .. 370
SGU 1-19 (Schweizer) .. *(1951-52)* 288c
SGU S-22-C (Schweizer) 369
Sh(a)-10 (Sheremetov) .. *(1950-51)* 173c
ShchE-2 (Shcherbakov) .. *(1953-54)* 179
Si 204D (Siebel) .. .. *(1945-46)* 146c
Si 222 Super-Hummel (Siebel) *(1957-58)* 178
SIPA (see Société Industrielle pour l'Aeronautiëue .. *(1957-58)* 163
SIA 200 (Sipa) .. *(1956-57)* 158
SIPA 300 (Sipa) .. *(1956-57)* 158
SIPA 1000 Coccinelle (Sipa) *(1957-58)* 163
SIPA 1100 (Sipa) 166
SK 50 (Saab) 245
SK.1 (Somers Kendall) .. *(1957-58)* 102

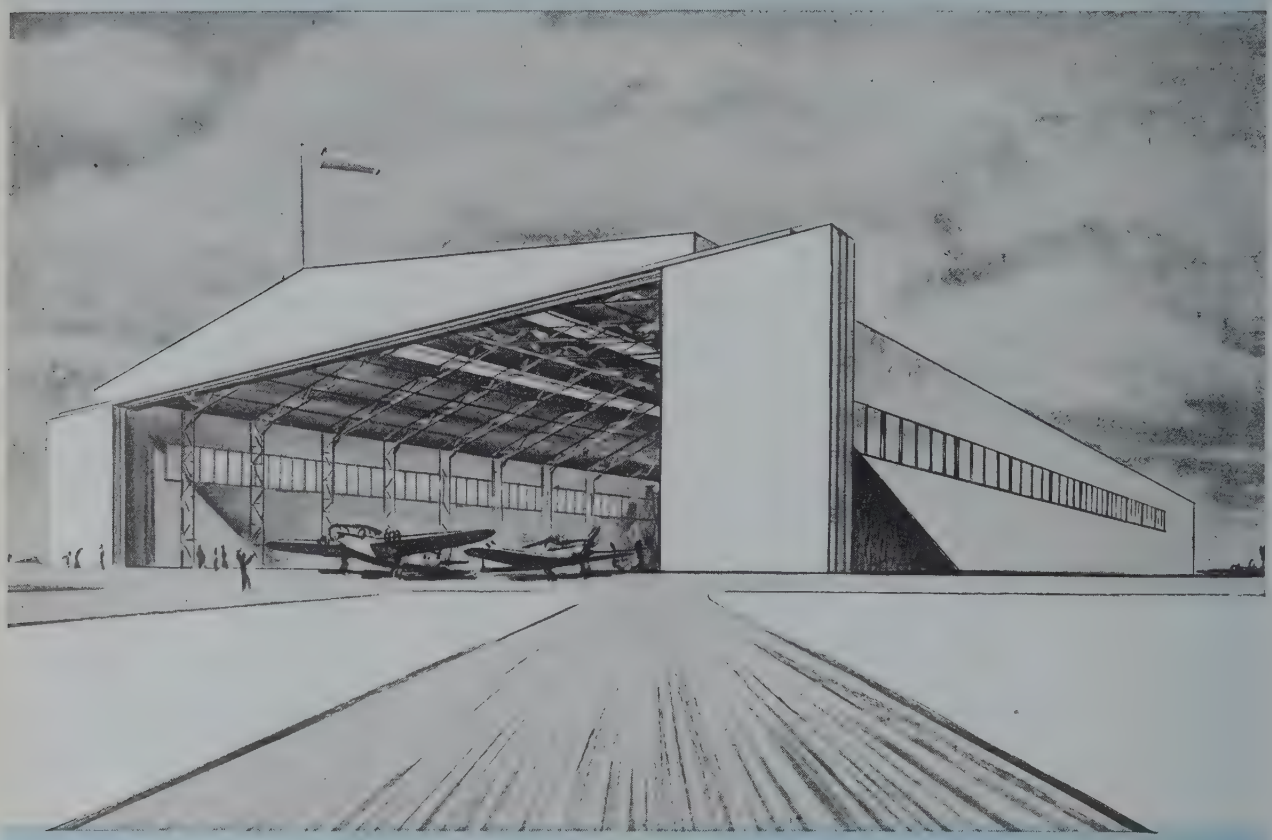
PAGE

SM-1 (Poland) 211
SM-62 Snark (Northrop) .. *(1957-58)* 345
SM.95 (SIAI-Marchetti) .. *(1951-52)* 162c
SM.101 (SIAI-Marchetti) .. *(1950-51)* 158c
SM.102 (SIAI-Marchetti) .. *(1951-52)* 161c
SNB-5 (Beechcraft) .. *(1955-56)* 217
S.N.C.A.N. (See Nord) .. *(1956-57)* 146
S.N.C.A.S.E. (see Sud-Est) .. *(1955-56)* 158
S.N.C.A.S.O. (see Sud-Ouest) (1955-56) 160
SNECMA (Société Nationale d'Etude et de Constructions de Moteurs d'Aviation) 166
SNJ Texan (North American) (1948) 304c
S.O. 30 Nene (Sud-Ouest) .. *(1953-54)* 153
S.O. 30C (Sud-Ouest) .. *(1951-52)* 145c
S.O. 30P (Sud-Ouest) .. *(1955-56)* 160
S.O. 94 (Sud-Ouest) .. *(1948)* 161c
S.O. 95 Corse II (Sud-Ouest) (1951-52) 146c
S.O. 1110 Ariel II (Sud-Ouest) *(1951-52)* 148c
S.O. 1120 Ariel III (Sud-Ouest) *(1954-55)* 157
S.O. 1221 (Sud) 172
S.O. 1310 (Sud-Ouest) .. *(1955-56)* 163
S.O. 4000 (Sud-Ouest) .. *(1952-53)* 133c
S.O. 4050 Vautour (Sud) 169
S.O. 6000 (Sud-Ouest) .. *(1951-52)* 147
S.O. 6020 Espadon (Sud-Ouest) *(1953-54)* 154
S.O. 7010 Pégase (Sud-Ouest) *(1950-51)* 144c
S.O. 7050 (Sud-Ouest) .. *(1948)* 162c
S.O. 7060 Deauville (Sud-Ouest) *(1950-51)* 144c
S.O. 8000 (Sud-Ouest) .. *(1949-50)* 136c
S.O. 9000 (Ouest-Aviation) .. *(1956-57)* 154
S.O. 9050 Trident II (Sud) .. 170
S.O. M.1 (Sud-Ouest) .. *(1950-51)* 144c
S.O. M.1 (Sud-Ouest) .. *(1951-52)* 146c
S.O. M.2 (Sud-Ouest) .. *(1952-53)* 133
SR.7B (Stampe Renard) .. *(1957-58)* 45
SR.45 Princess (Saunders-Roe) *(1955-56)* 92
S-R.53 (Saunders Roe) .. *(1957-58)* 95
SR.A1 (Saunders Roe) .. *(1951-52)* 74c
SRX-1 (Robertson) .. *(1954-55)* 290
S.U.C. 10 Courlis (S.E.C.A.N.) *(1951-52)* 139c
SZD-8L Jaskolka (Poland) *(1956-57)* 194
SZD-8*bis* Jazkolka (Poland) .. 213
SZD-8*bis* Jazkolka Z (Poland) .. 213
SZD-9*bis* Bocian (Poland) 213
SZD-10 Czapla (Poland) 213
SZD-12 Mucha 100 (Poland) .. 212
SZD-15 Broka (Poland) 213
SZD-18 Czajka (Poland) 213
SZD Kania (Poland) 209
SAAB (see Svenska Aeroplan A.B.) *(1957-58)* 233
Saab-17 .. .. *(1950-51)* 187c
Saab 18 .. .. *(1951-52)* 187c
Saab 21A .. .. *(1951-52)* 187c
Saab 21R .. .. *(1951-52)* 186c
Saab-29 244
Saab-32 Lansen 243
Saab-35 Draken .. .. *(1957-58)* 233
Saab-35A Draken 242
Saab-90 Scandia .. .. *(1956-57)* 219
Saab-91 Safir .. .. *(1957-58)* 237
Saab-91A Safir 245
Saab-91B Safir 245
Saab-91C Safir 246
Saab-91D Safir 246
Saab 210 Draken .. *(1957-58)* 233
Sabre (Canadair) 125
Sabre CA-27 (Commonwealth) .. 117
Sabre (North American) 351
Sabreliner (North American) .. 348
Saeta (Hispano) 241
Safari (Frye) .. .. *(1957-58)* 297
Safir (Saab) 245
Sagittario (Ambrosini) .. *(1954-55)* 162
Sagittario 2 (Aerfar) 187
Sahara (Breguet) 145
Saiman (see Societa Anonima Industrie Meccaniche Aeronautiche Navali) *(1951-52)* 161c
Salamandra 53 (Poland) 213
SALVAY-STARK AIRCRAFT COMPANY (U.S.A.) 369
Samaritan (Convair) .. *(1957-58)* 280
Samu Geonczy SG.2 .. *(1951-52)* 149c
Sandringham (Short) .. *(1951-52)* 81c
Saracura (I.P.T.) .. *(1951-52)* 12c
SARO (see Saunders-Roe, Ltd.) *(1956-57)* 87
Satellite (Planet) .. .. *(1948)* 86c
Satellite (Superior) 378
SAUNDERS-ROE LTD. (G.B.) .. 97
Savage AJ (North American) *(1955-56)* 298
Scandia (Saab) .. .. *(1957-58)* 219
SCHEIBE-FLUGZEUGBAU G.m.b.H. (Germany) 179
Schulmeister (Burgfalke) 175

GENERAL UTILITY

STEEL BUILDINGS

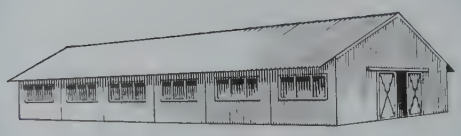
AND HANGARS

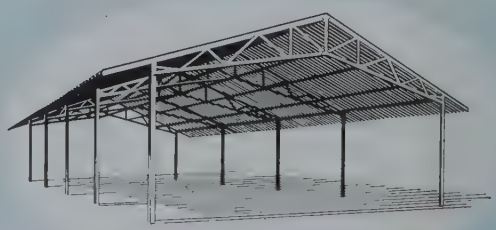


STANDARD DESIGNS 200′ 0″ TO 30′ 0″ SPANS

STEEL ECONOMY · SPACE ECONOMY

TROPICAL SHEDS & HOUSES · GODOWNS · BARRACKS · OFFICES ETC.





We supply and erect
in any part of the world

BELLMAN HANGARS

LIMITED

HOBART HOUSE, LONDON, S.W.1. TEL: SLOANE 5259 · CABLES: UNITSTRUCT, LONDON

PAGE

SCHWEIZER AIRCRAFT CORPORATION (U.S.A.) 369
Scimitar (Supermarine) 103
Scorpion F-89 (Northrop) 356
SCOTTISH AVIATION, LTD. (G.B.) 98
Scout (Boeing) .. .. *(1950-51)* 209c
Sea Attacker (Supermarine) *(1948)* 99c
Seabird (Taylorcraft) 379
Sea Dart (Convair) .. *(1956-57)* 253
Sea Devon (de Havilland) .. *(1956-57)* 71
Seafire (Supermarine) .. *(1951-52)* 86c
Seaford (Short) .. .. *(1948)* 94c
Sea Fury (Hawker) .. *(1955-56)* 85
Seagull (Supermarine) .. *(1951-52)* 87c
Sea Hawk (Armstrong) 51
Sea Hornet (D.H.) .. *(1951-52)* 45c
Sealand (Short) .. .. *(1954-55)* 95
Seamaster (Martin) 342
Seamew (Short) .. .. *(1956-57)* 90
Sea Meteor (Gloster) .. *(1951-52)* 57c
Sea Mosquito (D.H.) .. *(1950-51)* 52c
Sea Otter (Supermarine) .. *(1949-50)* 87c
Sea Prince (Hunting Percival) *(1956-57)* 85
Seastar (Lockheed) 334
Sea Vampire (D.H.) .. *(1954-55)* 65
Sea Venom (D.H.) 68
Sea Vixen (D.H.) 68
Sedan (Aeronca) .. .. *(1952-53)* 172
Sedbergh (Slingsby) 103
SEIBEL (Helicopter Division Cessna Aircraft Co.) (U.S.A.) .. *(1953-54)* 273
Seminole (Beechcraft) 256
Seneca (Cessna) 276
Sep (Poland) .. .. *(1953-54)* 174
Seven Seas (Douglas) 298
Shackleton (Avro) 57
Shawnee (Vertol) 383
SHCHERBAKOV, S.O. (Russia) .. 186
Sherpa (Short) .. .. *(1955-56)* 96
Shetland (Short) .. .. *(1949-50)* 79c
SHIN MITSUBISHI JUKOGYO K.K. (Japan) 201
SHIN TACHIKAWA KOKUKI K.K. 202
Shooting Star (Lockheed) .. *(1957-58)* 324
SHORT BROTHERS & HARLAND LTD. (G.B.) 100
SHOWA HIKOKI KOGYO K.K. (Japan) 202
Shturmovik (Ilyushin) .. *(1955-56)* 191
SIAI-MARCHETTI, SOCIETA PER AZIONI (Italy) .. *(1957-58)* 193
SIEBELWERKE-ATG G.m.b.H. .. 185
SIKORSKY AIRCRAFT DIVISION OF UNITED AIRCRAFT CORPORATION (U.S.A.) 370
Sikumbang (Indonesia) .. *(1957-58)* 181
Silary (Hungary) 184
SILVAIRE AIRCRAFT CORPORATION (U.S.A.) 375
Silvaire 8A Sky Pal (Luscombe) *(1949-50)* 244c
Silvaire 8F (Luscombe) .. *(1949-50* 243c
Silvaire 8-F (Silvaire) .. *(1957-58)* 362
Silvaire T8F Observer (Luscombe) *(1949-50)* 244c
Silvaire Sedan (Luscombe) .. *(1949-50)* 243c
Silvaire Sprayer (Luscombe) *(1949-50)* 244c
Silver Star (Canadair) 126
Sioux (Bell) 259
SIPA (see Société Industrielle pour l'Aeronautique) 165
SKANDINAVISK AERO INDUSTRI A/S (Denmark) .. *(1957-58)* 134
Skaut M.2 (Czechoslovakia) .. *(1951-52)* 109c
Skeeter (Saunders Roe) 97
Skimmer (Colonial) 280
Sky (Slingsby) .. .. *(1957-58)* 100
Sky-Coupe (Stits) 376
Skyhawk (Douglas) 293
Sky Hook (Rotor-Craft) 367
Skyhopper (Salvay-Stark) 369
Skyhawk S-4A (Seibel) .. *(1951-52)* 288c
Skyjeep (Chrislea) .. *(1951-52)* 37c
Skyknight (Douglas) .. *(1954-55)* 238
Skylancer (Douglas) .. *(1957-58)* 284
Skylane (Cessna) 276
Skylark (Robertson) .. *(1954-55)* 290
Skylark 2 (Slingsby) 102
Skylark 3B (Slingsby) 102
Skymaster (Douglas) .. *(1956-57)* 277
Sky Pal (Luscombe) .. *(1949-50)* 244c
Skyraider (Douglas) .. *(1957-58)* 288
Skyray (Douglas) 293
Skyrocket (Douglas) .. *(1954-55)* 236
Skyrocket (Northwest Industries) *(1949-50)* 96c
Sky Scooter (Thorp) .. *(1950-51)* 285c
Skyshark (Douglas) .. *(1954-55)* 240
Skystreak (Douglas) .. *(1954-55)* 236
Skytrain (Douglas) .. *(1951-52)* 234c
Skywarrior (Douglas) 294
SLINGSBY SAILPLANES LTD (G.B.) 102
Snark (Northrop) .. *(1957-58)* 345

PAGE

SOBEH (Netherlands) .. *(1955-56)* 184
SOCIEDADE CONSTRUTORA AERONAUTICA NEIVA, LTDA. (Brazil) 48
SOCIETA AERONAUTICA ITALIANA ING. A. AMBROSINI & C (Italy) 189
SOCIETA ANONIMA INDUSTRIE MECCANICHE AERONAUTICHE NAVALI (Italy) .. *(1951-52)* 157c
SOCIETA PER AZIONI COSTRUZIONI AERONAVALI (Italy) *(1951-52)* 157c
SOCIETA PER AZIONI SIAI-MARCHETTI (Italy) 199
SOCIÉTÉ ANONYME BELGE DE CONSTRUCTIONS AÉRONAUTIQUES (Belgium) 47
SOCIÉTÉ D'ETUDES ET DE CONSTRUCTIONS AÉRO-NAVALES (France) .. .. *(1954-55)* 151
SOCIÉTÉ D'ETUDES VICTOR MINIÉ AVIATION (see Minié) (France) .. .. *(1953-54)* 142
SOCIÉTÉ DE CONSTRUCTIONS DE AERO NAVALES DE PORTNEUF (France) .. *(1952-53)* 127
SOCIÉTÉ DES AVIONS FRANCOIS REY (France) .. *(1952-53)* 126
SOCIÉTÉ FRANCAISE D'ETUDES ET DE CONSTRUCTIONS DE MATERIELS AÉRONAUTIQUE SPECIAUX (France) (see Nord) *(1955-56)* 150
SOCIÉTÉ INDUSTRIELLE POUR L'AERONAUTIQUE (France) .. 165
SOCIÉTÉ NATIONALE DE CONSTRUCTIONS AÉRONAUTIQUES DE SUD-EST (France) *(1955-56)* 158
SOCIÉTÉ NATIONALE DE CONSTRUCTIONS AÉRONAUTIQUES DU SUD-OUEST (see Ouest-Aviation) (France) .. *(1956-57)* 152
SOCIÉTÉ NATIONALE DE CONSTRUCTIONS AÉRONAUTIQUES DU NORD (S.N.C.A.N.) (France) *(1957-58)* 157
SOCIÉTÉ NATIONALE D'ETUDE ET DE CONSTRUCTION DE MOTORS D'AVIATION (SNECMA (France) 166
SOhaj 2 LGo25 (Czechoslovakia) *(1953-54)* 120
Sokol MID Falcon (Czechoslovakia) *(1955-56)* 124
Solent (Short) .. .. *(1951-52)* 81c
SOMERS KENDALL AIRCRAFT, LTD. (G.B.) .. .. *(1957-58)* 103
SOVROMTRACTOR (Rumania) *(1957-58)* 208
Sparrowjet M.77 (Miles) .. *(1955-56)* 91
Sparviero (Pasotti) .. *(1957-58)* 191
Specht (Scheibe) 180
Special de Luxe (Taylorcraft) *(1954-55)* 296
Sperber (Scheibe) .. *(1957-58)* 177
Spatz-55 (Scheibe) .. *(1957-58)* 177
Sperling (Scheibe) 179
Sperber (Scheibe) 180
Spitfire (Supermarine) .. *(1950-51)* 88c
Spitfire Trainer (Supermarine) *(1951-52)* 86c
Sportsman (Taylorcraft) .. *(1954-55)* 296
Sprayer (Luscombe) .. *(1949-50)* 244c
Sprite (Essex Aero) .. *(1948)* 59c
Squall (Valmet) .. .. *(1956-57)* 140
Sroka (Poland) 213
STAMPE ET RENARD (Belgium) (see Constructions Aéronautiques Stampe et Renard (SA) .. *(1957-58)* 45
Stampe S.V. 4C (Nord) .. *(1948)* 151c
Standard (Ercoupe) .. *(1949-50)* 222c
Stankov (Yugoslavia) .. *(1952-53)* 247
STARCK, AVIONS ANDRÉ (France) *(1953-54)* 149
Starfire (Lockheed) .. *(1956-57)* 307
Starfighter (Lockheed) 331
Starflight (Monsted-Vincent) *(1949-50)* 256c
Starliner (Lockheed) 331
STATE AIRCRAFT FACTORY (Chinese People's Republic) .. 133
STATE AIRCRAFT FACTORY (United Arab Republic) 138
Statoplan O1 (Gatard) 154
Statoplan O2 (Gatard) 154
STITS AIRCRAFT (U.S.A.) .. 376
Stormovik (Ilyushin) .. *(1948)* 185c
Stout Bushmaster (Hayden) .. 312
Stratocruiser (Boeing) 269
Strato-Courier (Helio) 314
Stratofreighter (Boeing) 270
Stratofortress (Boeing) 267
Stratojet (Boeing) .. . 268
Stratoliner 707 (Boeing) .. *(1957-58)* 254
Stratotanker (Boeing) .. *(1957-58)* 255

PAGE

Stratus (I.P.T.) .. *(1951-52)* 13c
STREAK AERO CORPORATION (U.S.A.) .. .. *(1954-55)* 295
Streak-85 (Aero-Flight) .. *(1950-51)* 196c
Streak-125 (Aero-Flight) .. *(1950-51)* 196c
Streak-165 (Aero-Flight) .. *(1952-53)* 171
Streak-225 (Streak) .. *(1954-55)* 295
STROUKOFF AIRCRAFT CORP. (U.S.A.) 377
Student (Miles) 94
Sturgeon (Short) .. .. *(1954-55)* 94
SUD-AVIATION, SOCIÉTÉ NATIONALE, DE CONSTRUCTIONS AÉRONAUTIQUE (France) .. 167
SUD-EST, SOCIÉTÉ NATIONALE DE CONSTRUCTIONS AÉRONAUTIQUES (France) .. *(1956-57)* 153
SUD-OUEST, SOCIÉTÉ NATIONALE DE CONSTRUCTIONS AÉRONAUTIQUES DU (France) *(1955-56)* 160
SUKHANOV (Soviet Union) .. 227
SUKHOI, PAVEL OSIPEVICH (Soviet Union) 227
Sunderland (Short) .. *(1951-52)* 82c
Super (Aero) .. .. *(1956-57)* 227
Super-18 (Beechcraft) 257
Super DC-3 (Douglas) .. *(1951-52)* 232c
Super-T6 (Bacon) 253
Super S.7 (Ambrosini) .. *(1956-57)* 170
Super Ace (Chrislea) .. *(1951-52)* 37c
Super Aero 45 (Czechoslovakia) .. 136
Super Alouette (Sud) 171
Super Brigadier (Baumann) .. 253
Super Broussard (Max Holste) *(1957-58)* 156
Super Cadet (Callair) .. *(1956-57)* 245
Super Chief (Aeronca) .. *(1949-50* 188c
Super Cigale (Aubert) 142
Super Constellation (Lockheed) .. 328
Super Cruiser (Piper) .. *(1948)* 310c
Supercab (C.A.B.) .. *(1956-57)* 133
Super Broussard (Max Holste) .. 158
Super Cub "95" (Piper) 361
Super Cub "150" (Piper) 361
Super-Futar (Hungary) 184
Super-Hummel (Siebel) .. *(1957-58)* 178
Super Mystere (Dassault) 150
Super Phrygane (C.F.A.) .. *(1953-54)* 130
Superfortress (Boeing) .. *(1953-54)* 209
Superfortress (Hayes) 313
SUPERIOR AIRCRAFT CO. (U.S.A.) 377
SUPERMARINE (see Vickers-Armstrongs (Aircraft) Ltd. (Supermarine Works) 103
Super Sabre (North American) .. 349
Super Star (Lockheed) .. *(1956-57)* 304
Super Ventura (Howard) 318
Super Widgeon (McKinnon) .. 340
Surveillance Drone (Fairchild) .. 303
Survey Prince IIIA (Hunting Percival) *(1955-56)* 89
SVENSKA AEROPLAN A.B. (Sweden) 242
Swallow (Slingsby) 102
Swift (Supermarine) 104
Swift (Temco) .. .. *(1951-52)* 292c
Sycamore (Bristol) 64
Sylphe (Fouga) .. .. *(1954-55)* 139
Szpak-2 (Poland) .. *(1951-52)* 166c
Szpak-3 (Poland) .. *(1951-52)* 166c
Szpak-4 (Poland) .. *(1955-56)* 186

T

T. Mk. 5 Firefly (Fairey, Australia) *(1955-56)* 112
T-1 (Rawdon) 363
T-1S (Rawdon) 364
T-1D (Rawdon) 364
T1F1 (Fuji) .. .. *(1957-58)* 194
T1F2 (Fuji) 200
T2J (North American) 353
T2J-1 (North American) 353
T2V-1 (Lockheed) 334
T-6G Texan (North American) *(1952-53)* 234
T-11 Sky Scooter (Thorp) .. *(1950-51)* 285c
T-18 (Snab) .. .. *(1951-52)* 187c
T-28 (North American) 354
T-29 (Convair) 287
T.30 (Fairchild) .. .. *(1949-50)* 223c
T-33 Shooting Star (Lockheed) .. 333
T-34 (Beechcraft) .. *(1957-58)* 245
T-34A (Beechcraft) 255
T-34B (Beechcraft) 255
T-35 Buckaroo (Temco) .. *(1953-54)* 277
T-36 (Beechcraft) .. *(1952-53)* 174
T-37A (Cessna) 272
T-38 (Northrop) 355
T.66 Tipsy Nipper (Avions Fairey) .. 46

PAGE

T.5.510 (Nord) .. .. *(1956-57)* 151
TBM 3W (Grumman) .. *(1951-52)* 246c
TBM 3S (Grumman) .. *(1951-52)* 246c
TC-131 (Convair) .. *(1957-58)* 280
TE-1 (Eklund) .. .. *(1956-57)* 128
TE-1B (Eklund) .. *(1956-57)* 124
TE-1 Buckaroo (Temco) .. *(1953-54)* 277
TF Trader (Grumman) 310
TF-80 (Lockheed) .. *(1949-50)* 240c
TF-102A (Convair) 283
T.H.K, (see Turk Hava Kurumu Ucak Fabrikasi) .. .. *(1953-54)* 193
T.H.K.2 (see M.K.E.K.7) .. *(1956-57)* 224
T.H.K.5 (see M.K.E.K.5) .. *(1956-57)* 224
T.H.K.5A (see M.K.E.K.5A) *(1956-57)* 224
T.H.K 10 .. .. *(1948)* 208c
T.H.K 11 .. .. *(1952-53)* 168
T.H.K.13 .. .. *(1952-53)* 168
T.H.K 14 (see M.K.E.K.6) *(1956-57)* 224
T.H.K 16 (see M.K.E.K.2) *(1955-56)* 211
TM-61 (Martin) .. .. *(1957-58)* 335
TM-76 (Martin) .. .. *(1957-58)* 335
TO-1 (Lockheed) .. .. *(1951-52)* 254c
TO-2 (Lockheed) .. .. *(1951-52)* 254c
TOM-8 (Czechoslovakia) .. *(1957-58)* 129
TS-8 Bies (Poland) 210
TS-11 Iskra (Poland) 208
TS Jet Trainer (Poland) .. *(1957-58)* 205
TT-1 (Temco) 379
TTX (Temco) 379
TT-10 (Toyo) .. .. *(1956-57)* 186
TU-2 (Tupolev) .. .. *(1953-54)* 181
TU.4 (Tupolev) .. *(1955-56)* 193
TU-6 (Tupolev) .. .. *(1953-54)* 180
TU-12 (Tupolev) .. *(1953-54)* 180
TU-70 (Tupolev) .. *(1951-52)* 176c
TU-14 (Tupolev) 230
TU-16 (Tupolev) 230
TU-20(?) (Tupolev) 230
TU-104 (Tupolev) 229
TU-110 (Tupolev) 229
TU-114 (Tupolev) 228
TUG-75 (Tupolev) .. *(1955-56)* 193
TV2 (Lockheed) 333
Tachihi R-53 (Tachikawa) 202
Tachihi R-HM (Shin Tachikawa) *(1957-58)* 195
TACHIKAWA KOKUKI K.K. (Japan) 202
Tagak (Philippine) .. *(1957-58)* 202
TALLERAS GENERALES DE AERONAUTICO MILITAR (Mexico) *(1952-53)* 144
Tamdem Tutor (Slingsby) .. *(1957-58)* 101
Tanker (Kingsford Smith) .. *(1957-58)* 117
Tanker-Transport (Boeing) .. *(1955-56)* 224
Taon (Breguet) 144
Tartuca (C.V.V.) .. *(1951-52* 154c
TAYLORCRAFT, INC. (U.S.A.) 378
Taylorcraft Model 47 .. *(1948)* 122c
Teal (Temco) 380
TEMCO AIRCRAFT CORPORATION (U.S.A.) 379
Tempest (Hawker) .. *(1949-50)* 67c
Tempête (Jurca) 157
Texan (North American) .. *(1952-53)* 234
TEXAS (see Aircraft Manufacturing Co.) .. .. *(1951-52)* 292c
TEXAS A. & M. COLLEGE, AIRCRAFT RESEARCH CENTER (U.S.A.) 380
TEXAS AIRCRAFT CORPORATION (U.S.A.) .. .. *(1952-53)* 245
THOMPSON, CARL (U.S.A.) .. 381
Thruxton (Jackaroo) 92
Thunderchief (Republic) 365
Thunderflash (Republic) .. *(1957-58)* 354
Thunderjet (Republic) .. *(1955-56)* 309
Thunderstreak (Republic) .. *(1957-58)* 353
Thruxton Jackaroo (Jackaroo) .. 92
Tiger (Grumman) 307
Tigercat (Grumman) .. *(1948)* 265c
Tipsy Nipper (Avions Fairey) .. 46
Tom-8 (Czechoslovakia) 133
Top Sergeant (American Helicopter) *(1951-52)* 196c
Topper (Taylorcraft) 379
Tornado B-45 (North American) *(1951-52)* 273c
Tornado P-55 (Partenavia) 197
Tourist (Taylorcraft) .. *(1954-55)* 295
Town and Country (Custer) *(1956-57)* 263
TOYO KOKU K.K. (Japan) .. 202
Tri-Traveler (Champion) 277
Tracer (Grumman) 311
Tracker (Grumman) 309
Trader (Grumman) 310
Tradewind (Convair) .. *(1957-58)* 273
Trainer (Avions Fairey) .. *(1948)* 12c
TRANSCENDENTAL AIRCRAFT CORP. (U.S.A.) .. *(1957-58)* 369
TRANSLAND AIRCRAFT (U.S.A.) .. 381
Transporter (Vertol) .. *(1956-57)* 346
Trasimenus S.1002 (Ambrosini) *(1951-52)* 152c

PAGE

Travel Air (Beechcraft) 254
Traveler (Champion) 277
Traveler BC12D-65 (Taylorcraft) *(1951-52)* 290c
TRECKER AIRCRAFT CORPORATION (U.S.A.) 382
Trener-Master (Czechoslavakia) .. 135
Trener Zlin (Czechoslovakia) *(1951-52)* 108c
Trener Mk. 2 Zlin (Czechoslovakia) *(1957-58)* 131
Triana (Hispano) 240
Triciclo-Experimental (Chile) *(1953-54)* 103
Trident I (Ouest-Aviation) .. *(1956-57)* 154
Trident II (Sud) 170
Tri-Pacer (Piper) 360
Triton (Sud-Ouest) .. *(1951-52)* 147c
Tri-Traveler (Champion) .. *(1957-58)* 267
Trojan A-2 (Emigh Trojan) *(1950-51)* 232c
Trojka (Yugoslavia) 389
Trzmiel (Poland) 212
TSIBIN, P.V. (Russia) .. *(1954-55)* 186
Tubbi (Druine) .. .. *(1956-57)* 137
Tucano (Alaparmo) .. *(1950-51)* 146c
Tudor (Avro) .. .. *(1950-51)* 25c
Tuuli-III (Valmet) 140
Tuuli-IV (Valmet) 140
TUPOLEV, ANDREI NIKOLAEVICH (Soviet Union) 228
Tupolev Twin-jet Bomber (Tupolev) *(1948)* 182c
Turbi (Druine) 151
Turboboxcar (Fairchild) 302
Turboliner (Convair) .. *(1952-53)* 196
Turbolot (Matvieyev) 223
Turbulent (Rollason) 96
Turbulent (Druine) 151
TURK HAVA KURUMU UCAK FABRIKASI (Turkey) .. *(1953-54)* 193
Tuuli-III (Valmet) 140
Tuuli-IV (Valmet) 140
Tutor (Slingsby) .. .. *(1957-58)* 101
Twin (Omega) .. .. *(1957-58)* 345
Twin-Bonanza (Beechcraft) 256
Twin-Four (Langley) .. *(1948)* 276c
Twin-Mustang (North American) *(1950-51)* 266c
Twin Navion (Temco) .. *(1954-55)* 296
Twin Pioneer (Scottish Aviation) .. 98
Twin-Quad (Beechcraft) .. *(1949-50)* 191c
Twin-Stinson (Piper) .. *(1952-53)* 238
Type 5-A Finnmark (Norway) *(1949-50)* 155c
Type 21 Mk. 2 (Slingsby) *(1957-58)* 101
Type 21B Sedbergh (Slingsby) .. 103
Type 29 (Slingsby) .. *(1952-53)* 80
Type 30 (Slingsby) .. *(1957-58)* 101
Type 31 (Slingsby) .. *(1957-58)* 101
Type 34 (Slingsby) .. *(1957-58)* 100
Type 35 (Guerchais Roche) *(1948)* 140c
Type 37 (Slingsby) .. *(1954-55)* 95
Type 41 Skylark (Slingsby) .. 102
Type 42 Eagle (Slingsby) 102
Type 43 Skylark (Slingsby) .. 102
Type 45 Swallow (Slingsby) .. 102
Type 60 (Blackburn) .. *(1955-56)* 55
Type 65 (Blackburn) .. *(1955-56)* 55
Type 68 (Blackburn) .. *(1952-53)* 42
Type 69 Vertijet (Ryan) .. *(1956-57)* 333
Type 76 Deux-Ponts (Breguet) *(1952-53)* 111
Type 89 Mercure (Breguet) *(1951-52)* 188c
Type 96 Vultur (Breguet) .. *(1955-56)* 133
Type 97 Fulgur (Breguet) .. *(1951-52)* 118c
Type 111 Gyroplane (Breguet) *(1953-54)* 111
Type 152 (East Germany) 181
Type 156 Beaufighter (Bristol) *(1950-51)* 39c
Type 164 Brigand (Bristol) *(1951-52)* 36c
Type 167 Brabazon (Bristol) *(1952-53)* 45
Type 170 Freighter (Bristol) *(1956-57)* 56
Type 171 Sycamore (Bristol) .. 64
Type 173 Helicopter (Bristol) *(1957-58)* 62
Type 175 Britannia (Bristol) .. 62
Type 191 Helicopter (Bristol) .. 63
Type 192 Helicopter (Bristol) .. 63
Type 213 (Yugoslavia) .. *(1956-57)* 349
Type 214D (Yugoslavia) 389
Type 392 Attacker (Supermarine) *(1950-51)* 87c
Type 415 (Elliotts) 73
Type 419 Series IV Olympia (Elliotts) 73
Type 451-M (Yugoslavia) .. *(1956-57)* 347
Type 452-2 (Yugoslavia) 387
Type 508 (Supermarine) .. *(1955-56)* 100
Type 510 (Supermarine) .. *(1952-53)* 82
Type 522 (Yugoslavia) 388
Type 525 (Supermarine) .. *(1955-56)* 100
Type 535 (Supermarine) .. *(1952-53)* 82
Type 618 Nene-Viking (Vickers) *(1950-51)* 94c
Type 648 Varsity (Vickers) .. *(1949-50)* 91c
Type 651 Valetta (Vickers) *(1954-55)* 105
Type 668 Varsity (Vickers) *(1954-55)* 104
Type 674 Valiant (Vickers) *(1957-58)* 104
Type 696 (Avro) 57
Type 698 (Avro) 57
Type 707 (Avro) .. *(1955-56)* 52

PAGE

Type 763, 765 (Breguet) 145
Type 900 Sailplane (Breguet) *(1955-56)* 134
Type 901 (Breguet) 146
Type 902 (Breguet) 147
Type 904 (Breguet) 147
Type 905 (Breguet) 147
Type 940 (Breguet) 145
Type 941 (Breguet) .. *(1957-58)* 141
Type 960 (Breguet) .. *(1956-57)* 129
Type 965 (Breguet) .. *(1956-57)* 129
Type 1000 (Vickers) .. *(1955-56)* 101
Type 1001 (Breguet) 144
Type 1050 (Breguet) 144
Type 1100 (Breguet) .. *(1957-58)* 140

U

U-1 (D.H. Canada) 127
U-2 (Lockheed) 333
UC-1 (D.H. Canada) 127
UF-1 Albatross (Grumman) .. 311
UH-4 (Hiller) .. .. *(1948)* 269c
UH-12 (Hiller) 316
UH-12B (Hiller) .. *(1952-53)* 216
U-IL-28 (Ilyushin) .. .. *(1956-57)* 197
U-MIG-15 (MIG) .. *(1956-57)* 201
U.R.M.V.-3 (Rumania) 214
US-5 (Antonov) .. .. *(1951-52)* 170c
UT-2 (Yakovlev) .. .. *(1951-52)* 176c
Ugur (M.K.E.K.) 248
Ukraina (Antonev) 217
Ultra Light Helicopter (Fairey) *(1957-58)* 77
UNITED AIRCRAFT CORPORATION (U.S.A.) .. *(1952-53)* 247
Universal (Blackburn) .. *(1955-56)* 55
Universal (General Aircraft) *(1948)* 63c
Urubu (I.A.41) .. .. *(1956-57)* 39
Utility Mark I (M.L.) 93
Utility (Fletcher) 303
Utka (Mig) .. .. *(1950-51)* 171c
Utka (Duck) .. .. *(1948)* 188c

V

V2-1 Weejet (Carma) .. *(1957-58)* 262
VB 10 (Arsenal) .. *(1948)* 137c
VC10 (Vickers) 106
VC-121 (Lockheed) .. *(1957-58)* 319
VC-131 (Convair) .. *(1957-58)* 280
VC-137 (Boeing) 264
V.G.70 (Arsenal) .. *(1949-50)* 114c
V.G.90 (Arsenal) .. *(1952-53)* 109
VH-II (Valmet) 140
VH-III (Valmet) 141
VS-316A (Sikorsky) .. *1949-50)* 277c
VS-372 (Sikorsky) .. *(1949-50)* 278c
VT-1 (Carma) 272
VT-29 (Convair) 288
VTOL (Bell) .. .. *(1956-57)* 224
VZ-1E Pawnee (Hiller) 317
VZ-2 (Vertol) 385
VZ3RY Vertiplane (Ryan) 367
Vagabond (Piper) .. *(1949-50)* 269c
Valetta (Vickers) .. .. *(1954-55)* 105
Valiant (Vickers) 105
Valkyrie (North American) .. 348
Valmet (see Valtion Metallitehtaat Lentokonetehdas) .. *(1951-52)* 115c
VALMET O/Y, LENTOKONETEHDAS (Finland) 139
VALTION METALLITEHTAAT LENTOKONETEHDAS (Finland) *(1951-52)* 115c
Vampire (D.H.) .. .. *(1954-55)* 65
Vampire Night Fighter (D.H.) *(1954-55)* 66
Vampire Trainer (D.H.) 66
Vanguard (Vickers) .. *(1957-58)* 104
Vanguard 950 Series (Vickers-Armstrong) 106
Varsity (Vickers) .. *(1954-55)* 104
Vautour (Sud) 169
VELJEKSET KARHUMAKI O/Y (Finland) .. .. *(1955-56)* 128
Venom (D.H.) .. .. *(1956-57)* 62
VEREINEGUNG VOLKSEIGEMER BETRIESE FLUGZEUGBAU (East Germany) 181
VERTOL AIRCRAFT COMPANY (CANADA) LTD. (Canada) .. 130
VERTOL AIRCRAFT CORP. (U.S.A.) 382
Vertijet (Ryan) 368
Vertiplane (Ryan) .. *(1957-58)* 355
Vertolet (Kamov) .. .. *(1956-57)* 191
VERWALTUNG DER LUFTFAHRT-INDUSTRIE (East Germany) *(1957-58)* 178

PAGE

VIBERTI (see Ali Viberti S.p.A.) (*1951-52*) 162c
VICKERS (see Vickers-Armstrongs (Aircraft) Ltd. 105
VICKERS-ARMSTRONGS (AIRCRAFT) LTD. (G.B.) .. 105
VICKERS-ARMSTRONG (AIRCRAFT) LTD. (Supermarine Works) (G.B.) 103
Victor (Handley Page) 84
Vigilante (North American) .. 348
Vihuri (Valmet) 140
Viima Karhumaki .. (*1948*) 132c
Viking (Vickers) .. .. (*1952-53*) 87
Viscount 700 (Vickers-Armstrong) .. 108
Viscount 790 (Vickers-Armstrong) .. 110
Viscount 800 110
Viscount 810/840.. 111
Vogt LO 100 Zwergreiher (Burgfalke) .. 175
Vogt LO 150 (Burgfalke) 175
VOLKSEIGENE LUFTFAHRT-INDUSTRIE DER DEUTSCHEN DEMOKRATISCHEN REPUBLIK (East Germany) .. (*1957-58*) 178
Voltigeur (Sud) 169
Voodoo (McDonnell) 337
VOUGHT (see Chance Vought) (*1955-56*) 234
Voyager (Piper) .. .. (*1949-50*) 269c
Vulcan (Avro) 57
Vultur (Breguet) .. .. (*1956-57*) 129

W

W-6 (Aqua) .. .. (*1950-51*) 198c
W.11T (Saro Cierva) .. (*1951-52*) 76c
W.14 Skeeter (Cierva) .. (*1950-51*) 42c
W.35 (Westland) .. (*1949-50*) 92c
WA-20 Javelot (Wassmer) .. 173
WB-66 (Douglas) .. (*1957-58*) 288
WF-2 Tracer (Grumman) .. 311
WS-101A (Boeing) .. (*1957-58*) 257
WS-125A (Convair) 283
WV (Lockheed) 327
WASSMER, SOCIÉTÉ DES ÉTABLISSEMENTS BENJAMIN (France) 173
Wayfarer (Bristol) .. (*1949-50*) 35c
Wee Scotsman (Mooney) .. (*1954-55*) 275
Weejet VT-1 (Carma) 272
WESER, FINANZ-VERWALTUNGS GESELLSCHAFT (Germany) (*1956-57*) 167
"WESER" FLUGZEUGBAU G.m.b.H. (Germany) 181
Wessex (Westland) 114
WESTLAND AIRCRAFT, LTD. (G.B.) 112
Westland-Sikorsky S-51 (Westland) (*1955-56*) 105
Westland-Sikorsky S-55 (Westland) (*1955-56*) 107
Westminster (Westland) 115
Whirlwind (Westland) 113
Whirlaway (Bendix) .. (*1948*) 224c
WIDEROES FLYVESELSKAP OG POLARFLY A/S (Norway) (*1953-54*) 171
Widgeon (Grumman) .. (*1948*) 268c
Widgeon (Westland) 112
Winchester (Auster) 54
Windsor (Auster) 54
Winglet (Eshelman) .. (*1948*) 56c
WINICKI (Soviet Union) 231
Winjeel (Commonwealth) 118
Work Horse (Vertol) 383
Workmaster (Auster) 53
Wyvern (Westland) .. (*1956-57*) 101

X

X-1 (Bell) .. .. (*1956-57*) 232
X-2 (Bell) .. .. (*1957-58*) 248
X-3 (Douglas) .. .. (*1956-57*) 247
X-4 (Northrop) .. .. (*1953-54*) 263
X-5 (Bell) .. .. (*1953-54*) 201
X-7 (Lockheed) .. .. (*1957-58*) 328
X-10 (North American) .. (*1957-58*) 338
X-13 (Ryan) 368
X-14 (Bell) 258
X-15 (North American) 347
X-18 (Hiller) 315
X.116 Fonceur (Sud) .. (*1956-57*) 159
XAF-1 (Grumman) .. (*1948*) 263c
XAJ-1 (North American) .. (*1948*) 302c
XA2D-1 (Douglas) .. (*1953-54*) 225
XA3D-1 (Douglas) .. (*1952-53*) 201
XA2J-1 (North American) .. (*1953-54*) 261
XA4D-1 (Douglas) .. (*1953-54*) 225
XA-8 American Helicopter) (*1954-55*) 207
XB-45 (North American) .. (*1948*) 301c
XB-46 (Convair) .. (*1948*) 239c
XB-47 (Boeing) .. .. (*1949-50*) 196c
XB-48 (Martin) .. .. (*1950-51*) 255c

PAGE

XB-51 (Martin) .. (*1952-53*) 229
XB-58 (Convair) .. (*1954-55*) 229
XC-97 (Boeing) .. (*1949-50*) 198c
XC-99 (Convair) .. .. (*1951-52*) 222c
XC-120 Pack Plane (Fairchild) (*1951-52*) 236c
XC-122 Avitruc (Chase) .. (*1949-50*) 207c
XC-123 Avitruc (Chase) .. (*1950-51*) 215
XC-123D (Stroukoff) .. (*1956-57*) 316
XC-130 (Lockheed) .. (*1952-53*) 218
XC-133A (Douglas) .. (*1956-57*) 248
XCG-18A (Chase) .. (*1948*) 237c
XCH (McDonnell) .. (*1953-54*) 253
XE-14 (Hispano) .. (*1955-56*) 202
XF2Y (Convair) .. (*1954-55*) 226
XF3D-1 (Douglas) .. (*1948*) 246c
XF5U-1 (Chance Vought) (*1948*) 235c
XF6U-1 Pirate (Chance Vought) (*1949-50*) 205c
XF7U-1 Cutlass (Chance Vought) (*1949-50*) 205c
XF-9F (Grumman) .. (*1948*) 263c
XF10F-1 (Grumman) .. (*1953-54*) 235
XF 80 (Chance Vought) .. (*1955-56*) 234
XF-82 (North American) .. (*1948*) 302c
XF-84H (Republic) .. (*1956-57*) 333
XF-85 (McDonnell) .. (*1949-50*) 245c
XF-87 (Curtiss) .. .. (*1949-50*) 244c
XF-88 (McDonnell) .. (*1953-54*) 251
XF-89 (Northrop) .. (*1948*) 307c
XF-90 (Lockheed) .. (*1951-52*) 251c
XF-91 (Republic) .. (*1953-54*) 269
XF-92A (Convair) .. (*1953-54*) 216
XF-101 (McDonnell) .. (*1952-53*) 225
XF-102 (Convair) .. (*1953-54*) 216
XF-103 (Republic) .. (*1956-57*) 331
XF-104 (Lockheed) .. (*1955-56*) 279
XF-109 (Ryan) .. .. (*1955-56*) 310
XFJ-1 (North American) .. (*1948*) 300c
XFR-4 (Ryan) .. .. (*1948*) 315c
XFV-1 (Lockheed) .. (*1955-56*) 279
XFY-1 (Convair) .. (*1956-57*) 253
XH-8 (Kellett) .. .. (*1949-50*) 236c
XH-10 (Kellett) .. .. (*1949-50*) 236c
XH-13F (Bell) .. .. (*1955-56*) 220
XH-15 (Bell) .. .. (*1953-54*) 203
XH-16 (Kellett) .. .. (*1949-50*) 236c
XH-16 (Piasecki) .. (*1953-54*) 265
XH-17 (Hughes) .. .. (*1953-54*) 241
XH-20 (McDonnell) .. (*1952-53*) 226
XH-26 (American) .. (*1954-55*) 207
XH-39 (Sikorsky) .. (*1956-57*) 338
XH-40 (Bell) .. .. (*1957-58*) 249
XHCH-1 (McDonnell) .. (*1957-58*) 331
XHJF-1 (McDonnell) .. (*1949-50*) 248c
XHJP-1 (Piasecki) .. (*1949-50*) 266c
XHJS-1 (Sikorsky) .. (*1949-50*) 275c
XHR-2S (Sikorsky) .. (*1954-55*) 294
XHRH (McDonnell) .. (*1953-54*) 253
XHSL-1 (Bell) .. .. (*1953-54*) 203
XJR-2F (Grumman) .. (*1948*) 267c
XKD4R-1 (Radioplane) 362
XKDB-1 (Beechcraft) 257
XKDT-1 (Temco) 380
XL-14 Maya (Philippine) .. (*1956-57*) 192
XL-15 (Philippine) .. (*1957-58*) 202
XL-17 Musang (Philippine) .. 207
XL-19 (Cessna) .. (*1955-56*) 231
XL-25 McDonnell) .. (*1953-54*) 253
XM21 Firebee (Ryan) 356
XM-1000 (Molyneux) .. (*1957-58*) 117
XNQ-1 (Fairchild) .. (*1949-50*) 223c
XOSE-1 (Edo) .. .. (*1948*) 255c
XP5M-1 (Martin) .. (*1949-50*) 253c
XP5Y-1 (Convair) .. (*1953-54*) 216
XP6M (Martin) .. (*1956-57*) 314
XP-91 (Republic) .. (*1948*) 311c
XQ-2 Firebee (Ryan) 368
XQ-4 (Radioplane) 362
XR-11 (Hughes) .. (*1948*) 172c
XR-12 (Republic) .. (*1949-50*) 271c
XRB-49A (Northrop) .. (*1950-51*) 271c
XROE-1 (Hiller) 315
XRON-1 (Gyrodyne) 312
XSN2J-1 (North American) *1949-50*) 262c
XTB3F-1 (Grumman) .. (*1949-50*) 229c
XV-1 (McDonnell) .. (*1957-58*) 331
XV-3 (Bell) 259

Y

Y.A.5 (Blackburn) .. (*1950-51*) 29c
YH-32 (Hiller) 315
Yak-3 (Yakovlev) .. (*1950-51*) 179c
Yak-6 (Yakovlev) .. .. (*1948*) 192c
Yak-7 and 8 (Yakovlev) .. (*1950-51*) 179c
Yak-9P (Yakovlev) .. (*1953-54*) 183
Yak-10 (Yakovlev) .. (*1948*) 194c
Yak-11 (Yakovlev) 233
Yak-11U (Yakovlev) .. (*1957-58*) 224

PAGE

Yak-12 (Yakovlev) 233
Yak-14 (Yakovlev) .. (*1955-56*) 195
Yak-15 (Yakovlev) .. (*1952-53*) 157
Yak-16 (Yakovlev) .. (*1956-57*) 207
Yak-17 (Yakovlev) .. (*1955-56*) 194
Yak-18 (Yakovlev) 232
Yak-18U (Yakovlev) 232
Yak-20 (Yakovlev) 232
Yak-23 (Yakovlev) .. (*1956-57*) 206
Yak-24 (Yakovlev) 231
Yak-25 (Yakovlev) 231
Yak Transport Glider (Yakovlev) (*1951-52*) 187c
Y.B.1 (Blackburn) .. (*1951-52*) 26c
YB-35 (Northrop) .. (*1948*) 306c
YB.49 (Northrop) .. (*1950-51*) 270c
YB.60 (Convair) .. (*1953-54*) 217
YC-1B (de Havilland) 126
YC-47F (Douglas) .. (*1951-52*) 232c
YC-97 (Boeing) .. (*1949-50*) 198c
YC-121 (Lockheed) .. (*1957-58*) 319
YC-122C (Chase) .. (*1951-52*) 214c
YC-123 (Chase) .. (*1951-52*) 215c
YC-123E Pantobase (Stroukoff) (*1957-58*) 365
YC-131 (Convair) .. (*1957-58*) 244
YC-134 (Stroukoff) .. (*1957-58*) 364
YC-13A (Stroukoff 377
YC-135 (Convair) .. (*1953-54*) 221
YF-93 Sabre (North American) (*1950-51*) 262c
YF-102 (Convair) .. (*1955-56*) 238
YG-20 (C.A.B.) .. .. (*1955-56*) 136
YG-30 (C.A.B.) .. .. (*1955-56*) 136
YH-12 (Bell) .. .. (*1953-54*) 203
YH-13 (Bell) .. .. (*1951-52*) 201c
YH-15 (Bell) .. .. (*1950-51*) 203c
YH-16 (Vertol) .. .. (*1956-57*) 346
YH-18 (Sikorsky) .. (*1953-54*) 274
YH-24 (Siebel) .. .. (*1953-54*) 273
YH-30 (McCulloch) .. (*1954-55*) 266
YH-31 (Doman) .. .. (*1955-56*) 246
YH-32 (Hiller) .. .. (*1956-57*) 290
YH-32A (ULV) (Hiller) 316
YHC-1 (Vertol) 385
YHO-2 (Hughes).. 318
YH-41 (Cessna) 276
YHO-3 (Brantly) 271
YL 15 (Boeing) .. (*1950-51*) 209c
YL-24 (Helio) .. .. (*1954-55*) 255
YP6M-1 Sea Master (Martin) .. 342
YQ-1B (Radioplane) .. (*1956-57*) 328
YRB-49A Flying Wing (Northrop) (*1951-52*) 277c
YT-34 Mentor (Beechcraft) (*1952-53*) 174
YT-35 (Temco) .. .. (*1952-53*) 245
YAKOVLEV, ALEKSANDIR SERGEIOVICH (Soviet Union) 231
York (Avro) .. .. (*1949-50*) 25c
YUGOSLAVIAN GOVERNMENT FACTORIES .. .. (*1957-58*) 373

Z

Z-04 Béke (Hungary) 184
ZPG-2 (Goodyear) .. (*1957-58*) 487
ZPG-2W (Goodyear) .. (*1957-58*) 488
ZSG-4 (Goodyear) .. (*1957-58*) 487
ZS2G-1 (Goodyear) .. (*1957-58*) 487
Zak-1 (Poland) .. .. (*1953-54*) 173
Zak-2 (Poland) .. .. (*1953-54*) 173
Zak-3 (Poland) .. .. (*1955-56*) 186
Zappata (Breda) .. (*1948*) 164c
ZBOROWSKI, BUREAU TECHNIQUE (France) .. (*1957-58*) 171
Zephyr 400 (Taylorcraft) 378
Zlin 22 (Czechoslovakia) .. (*1956-57*) 122
Zlin 266 (Czechoslovakia) .. (*1956-57*) 121
Zlin 23 Honza (Czechoslovakia) (*1949-50*) 107c
Zlin 24 Krajanek (Czechoslovakia) (*1949-50*) 107c
Zlin 25 Sohaj (Czechoslovakia) (*1949-50*) 107c
Zlin 26 Trener (Czechoslovakia) (*1951-52*) 108c
Zlin 30 Kmotr (Czechoslovakia) (*1949-50*) 107c
Zlin 126 (Czechoslovakia) .. (*1957-58*) 131
Zlin 326 Trener-Master (Czechoslovakia) 135
Zlin 226 (Czechoslovakia) .. (*1957-58*) 131
Zlin 226T (Czechoslovakia) .. 135
Zlin 381 (Czechoslovakia) .. (*1951-52*) 109c
Zuch 1 (Poland) .. .. (*1951-52*) 168c
Zugrogel-III (Scheibe) 180
Zugrogel-IV (Scheibe) 181
Zuk (Poland) 211
Zurakowski Helicopter (Poland) (*1951-52*) 167c
Zuraw (Poland) .. .. (*1957-58*) 203
Zwergreiher (Burgfalke) 175

ROTARY WING AIRCRAFT

PAGE

A

AC-12 (Aerotecnica) 235
AC-13 (Aerotecnica) .. *(1955-56)* 197
AC-13A (Aerotecnica) 235
AC-14 (Aerotecnica) 236
AZ101D (Augusta) 189
Aérocentre N.C. 1002 Twin-rotor (1948) 135c
Aerocycle (De Lackner) .. *(1957-58)* 281
AEROTECNICA S.A. (Spain) .. 235
AGUSTA, COSTRUZIONI AERONAUTICHE GIAVANNI (Italy) (1956-57) 188
AER LUALDI & S.p.A. (Italy) .. 193
Air Horse (Saro Cierva) *(1951-52)* 75c
Alouette (Sud-Est) .. *(1953-54)* 151
Alouette II (Sud-Est) .. *(1957-58)* 170
AMERICAN HELICOPTER COMPANY INC. (U.S.A.) .. *(1954-55)* 206
Ariel (Sud-Ouest) .. *(1951-52)* 148c
Ariel III (Sud-Ouest) .. *(1954-55* 157
Army Mule (Vertol) 382

B

B-2 (Brantly) 271
B-3 (Brantly) 271
B-7 Gyro-Glider (Benson) 262
B-7B Gyro-Boat (Benson) 262
B-7M Gyro-Copter (Benson) .. 263
B-7W Hydro-Glider (Benson) .. 262
B-8M Gyro-Copter (Bensen) .. 263
B-8W Hydro-Glider (Bensen) .. 262
BS-12-SC Twin (Omega) .. *(1957-58)* 345
BELL HELICOPTER CORPORATION (U.S.A.) 259
Bell 47 (Agusta) .. .. *(1956-57)* 170
Bell 47B-3 Crop-dusting .. *(1948)* 220c
Bell 470 .. .. *(1948)* 221c
Bellairus (Bell) 261
BENSEN AIRCRAFT CORP. (U.S.A.) 262
BRANTLY HELICOPTER CORPORATION (U.S.A.) 271
Brantly Two-seat .. *(1948)* 231c
BREGUET, SOCIETE ANONYME DES AVIONS LOUIS (France) (1952-53) 111
BRISTOL AEROPLANE CO., LTD. (G.B.) 61
Bristol 171 .. .. *(1956-57)* 60
Bristol 173 .. .. *(1956-57)* 58
Bristol 191 .. .. *(1956-57)* 58
Bristol 192 .. .. *(1956-57)* 58
BS-12 Twin (Omega) .. *(1957-58)* 345
Buck Private (American Helicopter) (1951-52) 196c
BZ-4 Zuk (Poland) 211

C

C-1 (Capital) .. .. *(1955-56)* 229
CH-1 (Cessna) 276
CANTINIEAU, JEAN (France) (1953-54) 142
CAPITAL HELICOPTER CORPORATION (U.S.A.) .. *(1955-56)* 229
CESKOSLOVENSKE ZAVODY AUTOMOBILOVE A LETECKE (Czechoslovakia) .. *(1957-58)* 132
CESSNA AIRCRAFT CO. (U.S.A.) .. 272
Chickasaw (Sikorsky) 374
Choctaw (Sikorsky) 371
CIERVA (see Saunders Roe) (1951-52) 73c
Convertiplane (Bell) .. *(1955-56)* 219
Convertiplane (Jacobs) .. *(1955-56)* 270
Convertiplane (McDonnell) .. *(1955-56)* 286
CZECHOSLOVAK AUTOMOBILE AND AIRCRAFT WORKS (1957-58) 132
CONSTRUZIONI AERONAUTICHE GIOVANNI AGUSTA (Italy) .. 188

D

DH-4 Aerocycle (De Lackner) (1957-58) 281
DH-5 Aerocycle (De Lackner) .. 289
DH-28 (De Temple) 290
DETEMPLE HELICOPTERS, INC. (U.S.A.) 290
DE LACKNER HELICOPTERS INC. (U.S.A.) 289
Djinn (Sud) .. .. *(1957-58)* 170
DOMAN HELICOPTERS INC. (U.S.A.) 290
Drone (Kaman) 320
Dragonfly (Westland) .. *(1957-58)* 110

E

Experimental Helicopter (Hungary) .. 184

PAGE

F

FAIREY AVIATION CO., LTD. (G.B.) 79
Farfadet (Sud-Ouest) .. *(1955-56)* 163
FIAT SOCIETA PER (Italy) .. 192
Flying Platform (Hiller) 317
FLYRIDE (see Glenview Metal Products Co.) .. .. *(1956-57)* 281

G

G.11E Gyroplane (Breguet) .. *(1949-50)* 117c
GA-400R-3 Gizmo (Goodyear) .. 305
G.A1KF Fairey Gyrodyne (1948) 60c
G.C.A. 2A (Gyrodyne) .. *(1952-53)* 214
G.C.A. 2C (Gyrodyne) .. *(1953-54)* 238
G.C.A. 3 (Gyrodyne) .. *(1953-54)* 239
G.C.A. 7 Helidyne (Gyrodyne) (1951-52) 247c
G.I.L. Zurakowski Helicopter (Poland) (1951-52) 167c
GMP-1 (Flyride) .. *(1954-55)* 249
GMP-2 (Flyride) .. *(1956-57)* 281
Gizmo (Goodyear) 305
GLENVIEW METAL PRODUCTS CO. (U.S.A.) .. .. *(1956-57)* 281
GLUHAREFF HELICOPTER CORP. (U.S.A.) 305
GOODYEAR AIRCRAFT CORP. (U.S.A.) 305
Gouverner (Sud) .. .. *(1957-58)* 170
Gyro-Boat (Benson) 262
Gyro-Glider (Bensen) 262
Gyro-Copter (Bensen) 263
Gyrodyne (Fairey) .. *(1957-58)* 253
Gyrodyne (Jacobs) .. *(1955-56)* 270
GYRODYNE COMPANY OF AMERICA INC. (U.S.A.) 312
Gyroplane (Breguet) .. *(1949-50)* 117c

H

H-2 (Landgraf) .. .. *(1949-50)* 236c
H-2 (SOBEH) .. .. *(1955-56)* 184
H-2 (N.H.I.) .. .. *(1956-57)* 191
H-3 Kolibrie (N.H.I.) 206
H-4 (Sikorsky) .. .. *(1949-50)* 277
H-5 (Sikorsky) .. .. *(1954-55)* 292
H-12 (Bell) .. .. *(1952-53)* 178
H-13 (Bell) 259
H-13B (Bell) .. .. *(1951-52)* 201c
H-13G (Bell) .. .. *(1955-56)* 220
H-13J (Bell) 261
H-19 (Sikorsky) 374
H-21 (Vertol) 383
H-23 (Hiller) 316
H-25A (Vertol) 382
H-31 (Doman) .. .. *(1957-58)* 281
H-34 (Sikorsky) 371
H-37a (Sikorsky) 373
H-37 (Sikorsky) .. .. *(1957-58)* 360
H-39 (Sikorsky) .. .. *(1955-56)* 314
H-43 (Kaman) 320
HC-2 Heli-Baby (Czechoslovakia) (1957-58) 132
HJ-1 Hornet (Hiller) 315
HNS-1 (Sikorsky) .. *(1949-50)* 277c
HO2S-1 (Sikorsky) .. *(1949-50)* 278c
HO3S-1 (Sikorsky) .. *(1954-55)* 292
HO4S-1 (Sikorsky) 374
HO5S-1 (Sikorsky) .. *(1953-54)* 274
HOE-1 (Hiller) 315
HOK-1 (Kaman) 320
H.R. Mk. 13 (Bristol) .. *(1953-54)* 59
HRP (Vertol) .. .. *(1956-57)* 345
HR2S-1 (Sikorsky) 372
HRS (Sikorsky) 374
HSL-1 (Bell) 262
HSS-1 (Sikorsky) 371
HTE (Hiller) 316
HTK (Kaman) .. .. *(1957-58)* 311
HTL (Bell) 259
HTL-6 (Bell) .. .. *(1955-56)* 220
HTL-7 (Bell) .. .. *(1957-58)* 251
HU-1A Iroquois (Bell) 259
HU2K-1 (Kaman) 319
HUK-1 (Kaman) 320
HUL-1 (Bell) 261
HUP Retriever (Vertol) 382
HUS-2 (Sikorsky) 371
HUS-1 (Sikorsky) 371
Hare (Mil) 225
Hat (Kamov) 222
Helidyne (Gyrodyne) .. *(1953-54)* 239
Heli-Baby (Czechoslovakia) .. *(1957-58)* 132
Heli-Ventor (De Lackner) .. *(1955-56)* 246
Hen (Kamov) 222
HILLER AIRCRAFT CORPORATION (U.S.A.) 314

PAGE

Hog (Kamov) 222
Hook (Mil) 225
Hoppi-copter C-1 (Capital) .. *(1955-56)* 229
HOPPI-COPTERS, INC. (U.S.A.) (1953-54) 241
Hornet (Hiller) 315
Horse (Yakovlev) 231
Hound (Mil) 225
Hoverfly (Sikorsky) .. *(1949-50)* 277c
HUGHES AIRCRAFT COMPANY (U.S.A.) .. .. *(1953-54)* 241
HUGHES TOOL COMPANY, AIRCRAFT DIVISION (U.S.A.) .. 318
HUNTING PERCIVAL AIRCRAFT LTD. (G.B.) .. .. *(1955-56)* 86
Hydro-Glider (Bensen) 262

I

I-G (Transcendental) .. *(1957-58)* 344
Iroquois (Bell) 259

J

J (Bendix) Experimental .. *(1948)* 224c
J-1 (McDonnell) .. .. *(1950-51)* 253c
J-5 (Hiller) .. .. *(1948)* 269c
JOV-3 .. .. *(1950-51)* 243c
JACOBS AIRCRAFT ENGINE CO. (U.S.A.) .. .. *(1957-58)* 292
Jet Gyrodyne (Fairey) .. *(1956-57)* 73

K

K (Bendix) Experimental .. *(1948)* 224c
K-16B (Kaman) 319
K-17 (Kaman) 319
K.17 Vertolet (Kamov) .. *(1955-56)* 191
K-125-A Two-seat .. *(1948)* 273c
K-190 (Kaman) .. .. *(1949-50)* 236c
K-225 (Kaman) .. .. *(1953-54)* 243
K-600 (Kaman) 321
KA-2 (Kellett) .. .. *(1948)* 274c
KA-10 (Kamov) 222
KA-10M (Kamov) 222
KA-15 (Kamov) 222
KA-18 (Kamov) 222
KH-15 (Kellett) .. .. *(1957-58)* 313
KAMAN AIRCRAFT CORPORATION (U.S.A.) 310
KAMOV, N.I. (Soviet Union) .. 222
KELLETT AIRCRAFT CORPORATION (U.S.A.) 321
Kolibrie (N.H.I.) 206
Kotlinski Tzrmie (Poland) .. *(1957-58)* 206

L

L.55 (Lualdi) 193
LZ-1A (Doman) .. .. *(1949-50)* 213c
LZ-2A Pelican (Doman) .. *(1949-50)* 213c
LZ-4A (Doman) .. .. *(1952-53)* 197
LZ-5 (Doman) 290
Landgraf H-2 Single-seat .. *(1948)* 275c
Little Henry (McDonnell) .. *(1949-50)* 248c

M

M-14 Helicopter (Marquardt) *(1951-52)* 262c
MC-4 (McCulloch) .. *(1954-55)* 266
MC-101 (Matra-Cantinieau) *(1953-54)* 142
MEG-1X (Gluhareff) 305
MEG-2X (Gluhareff) 305
MEG-3X (Gluhareff) 305
MI-1 (Mil) 225
MI-1U (Mil) .. .. *(1957-58)* 219
MI-3 (Mil) 225
MI-4 (Mil) 225
MI-6 (Mil) 226
McCULLOCH MOTORS CORPORATION HELICOPTER DIVISION (U.S.A.) .. .. *(1954-55)* 266
McDONNELL AIRCRAFT CORPORATION (U.S.A.) .. *(1957-58)* 328
MARQUARDT AIRCRAFT COMPANY (U.S.A.) .. *(1951-52)* 262
MATRA-CANTINIEAU (France) (1953-54) 142
MIL, MIKHAIL L. (Russia) .. 225
Model 2 (Transcendental) .. *(1957-58)* 369
Model 42 (Vertol) 384
Model 42a (Vertol) 130
Model 44 (Vertol) 384
Model 47G (Bell) 259
Model 47H (Bell) .. *(1957-58)* 251
Model 47H-1 Bellairus (Bell) .. 261
Model 47J Ranger (Bell) .. *(1957-58)* 251
Model 61 (Bell) 262
Model 76 (Vertol) 385

PAGE

Model 82 (McDonnell) .. *(1957-58)* 331
Model 86 (McDonnell) .. *(1957-58)* 331
Model 107 (Vertol) 385
Model 200 (Bell) 259
Model 204 (Bell) 259
Model 212 (Bell) .. *(1957-58)* 249
Model 269 (Hughes) 318
Model 600 (Kaman) 320
Model 7002 (Fiat) 192
Mojave (Sikorsky) 372
MOLYNEUX HELICOPTER CO., PTY., LTD. (Australia) .. 120

N

NH-160 (Nagler) 346
N.H.I. (see Nederlandse Helicopter Ind. N.V.) .. .. *(1957-58)* 201
NAGLER HELICOPTER COMPANY, INC. (U.S.A.) 346
NEDERLANDSE HELICOPTER IND. N.V.) 206
NORD (S.N.C.A.N.) (France) *(1955-56)* 150
Nord 1700 Norélic Experimental (1948) 149c
Nord 1750 Norelfe .. *(1955-56)* 154
Norelfe (Nord) .. .. *(1955-56)* 154

O

OMEGA AIRCRAFT CORPORATION (U.S.A.) 358
OSRODEK KONSTRUKCJI LOTNICZYCH (Poland) .. 208
OUEST-AVIATION, SOCIÉTÉ NATIONALE DE CONSTRUCTIONS AÉRONAUTIQUES (see SUD) (France) .. .. *(1957-58)* 152

P

P.74 (Hunting Percival) .. *(1955-56)* 86
P.531 (Saunders-Roe) 97
PD-18 (Piasecki) .. *(1955-56)* 301
PD-22 (Piasecki) .. *(1955-56)* 302
PV-3 Rescuer (Piasecki) .. *(1955-56)* 302
PV-14 Retriever (Piasecki) .. *(1951-52)* 280c
PV-15 Transporter (Piasecki) *(1955-56)* 302
PV-17 (Piasecki) .. *(1955-56)* 302
Pawnee (Hiller) 317
Pelican (Doman) .. *(1951-52)* 223c
PIASECKI HELICOPTER CORPORATION (U.S.A.) (see Vertol Aircraft Corp.) .. .. *(1955-56)* 345
PIASECKI AIRCRAFT CORPORATION .. .. *(1957-58)* 347
Pinwheel (Rotor-Craft) 367

R

RH-1 (Rotor-Craft) 367
Ram-Jet Helicopter (McDonnell) (1952-53) 226
Ranger (Bell) 261
Raven (Hiller) 316
Rescuer (Vertol) .. .. *(1956-57)* 345
Retriever (Vertol) 382
Rotorcycle (Gyrodyne) 312
Rotodyne (Fairey) 80
ROTOR-CRAFT CORP. (U.S.A.) .. 366

S

S-4A (Siebel) .. .. *(1953-54)* 273
S-51 (Sikorsky) .. .. *(1954-55)* 292
S-51 (Westland) .. .. *(1955-56)* 105
S-52-2 (Sikorsky) .. *(1953-54)* 274
S-55 (Sikorsky) 374
S-55 (Westland) .. .. *(1955-56)* 107
S-56 (Sikorsky) .. .. *(1957-58)* 360
S-57 (Sikorsky) .. .. *(1955-56)* 314
S-58 (Sikorsky) 371
S-59 (Sikorsky) .. .. *(1956-57)* 338
S-61 (Sikorsky) 371
S-62 (Sikorsky) 371
S.E.3000 (Sud-Est) .. *(1950-51)* 140c
S.E.3101 (Sud-Est) .. *(1950-51)* 140c
S.E.3110 (Sud-Est) .. *(1950-51)* 140c
S-E.3120 (Sud-Est) .. *(1953-54)* 151
S.E.3130 (Sud) .. .. *(1957-58)* 170
S.E.3140 (Sud) .. .. *(1957-58)* 170
S.E.3200 (Sud) .. .. *(1957-58)* 170
SM-1 (Poland) 211
S.O.1110 Ariel II (Sud-Ouest) *(1951-52)* 148c
S.O.1120 Ariel III (Sud-Ouest) (1954-55) 157
S.O.1221 (Sud) .. .. *(1957-58)* 170
S.O.1310 (Sud-Ouest) .. *(1955-56)* 163
SARO (see Saunders-Roe, Ltd) (1956-57) 87
SAUNDERS-ROE LTD. (G.B.) (1956-57) 97
SEIBEL (Helicopter Division, Cessna Aircraft Co. (U.S.A.) .. *(1953-54)* 273
Seneca (Cessna) 276
Shaunee (Vertol) 383
SIKORSKY AIRCRAFT DIVISION UNITED AIRCRAFT CORPORATION (U.S.A.) 370
Sioux (Bell) 259
Skeeter (Saro) 97
Sky-Hawk S 4A (Seibel) .. *(1951-52)* 288c
Sky Hook (Rotor-Craft) 367
SOBEH (Netherlands) .. *(1955-56)* 184
SUD-AVIATION, SOCIÉTÉ NATIONALE DE CONSTRUCTIONS AÉRONAUTIQUES (France) (1957-58) 165
SUD-EST, SOCIÉTÉ NATIONALE DE CONSTRUCTIONS AÉRONAUTIQUES DU (France) (see Sud) (1956-57) 158
SUD-OUEST, SOCIÉTÉ NATIONALE DE CONSTRUCTIONS AÉRONAUTIQUES DU (see Ouest-aviation) (France) .. *(1956-57)* 152
Sycamore (Bristol) 64
Sznycer-Gottlieb SG V1-D .. *(1948)* 121c

T

Top Sergeant (American Helicopter) (1951-52) 196c
TRANSCENDENTAL AIRCRAFT CORP. (U.S.A.) .. *(1957-58)* 369
Transporter (Vertol) .. *(1956-57)* 346
Trzmiel (Poland) .. *(1957-58)* 206
Twin (Omega) .. .. *(1957-58)* 345
Type 111 Gyroplane (Breguet) *(1952-53)* 112
Type 171 Helicopter (Bristol) .. 64
Type 173 Helicopter (Bristol) *(1957-58)* 62
Type 191 Helicopter (Bristol) .. 63
Type 192 Helicopter (Bristol) .. 63

U

U-1 (D.H. Canada) .. *(1955-56)* 118
UC-1 (D.H. Canada) .. *(1955-56)* 118
UH 4 Commuter (Hiller) .. *(1948)* 269c
UH-12 (Hiller) 316
UH-12B (Hiller) .. *(1952-53)* 216
Ultra Light Helicopter (Fairey) .. 79

V

VS-316A (Sikorsky) .. *(1949-50)* 277c
VS-372 (Sikorsky) .. *(1949-50)* 278c
Vertol Aircraft Co. (Canada) Ltd. .. 130
VZ-1E Pawnee (Hiller) 317
VZ-2 (Vertol) 385
VERTOL AIRCRAFT CORP. (U.S.A.) 382
VTOL (Bell) .. .. *(1956-57)* 234
Vertolet (Kamov) .. *(1955-56)* 191

W

W-11T (Saro-Cierva) .. *(1951-52)* 76c
W.14 Skeeter (Cierva) .. *(1950-51)* 42c
Wessex (Westland) 114
WESTLAND AIRCRAFT LTD. .. 112
Westminster (Westland) 115
Whirlwind (Westland) 113
Widgeon (Westland) .. *(1957-58)* 110
Work Horse (Vertol) 383

X

X-18 (Hiller) 315
XA-5 Top Sergeant (American Helicopter) .. .. *(1951-52)* 196c
XA-6 Buck Private (American Helicopter .. .. *(1951-52)* 196c
XA-8 (American Helicopter) *(1954-55)* 207
XCH (McDonnell) .. *(1953-54)* 253
XH-8 (Kellett) .. .. *(1949-50)* 236c
XH-10 (Kellett) .. .. *(1949-50)* 236c
XH-12 (Model 48) Bell .. *(1948)* 222c
XH-13F (Bell) .. .. *(1956-57)* 220
XH-15 (Bell) .. *(1953-54)* 203
XH-16 (Piasecki) .. *(1953-54)* 265
XH-17 (Hughes) .. .. *(1953-54)* 241
XH-17 (Kellett) .. .. *(1949-50)* 236c
XH-20 (McDonnell) .. *(1952-53)* 226
XH-26 (American) .. *(1954-55)* 207
XH39 (Sikorsky) .. *(1956-57)* 338
XH-40 (Bell) .. .. *(1957-58)* 249
XCH-1 (McDonnell) .. *(1957-58)* 331
XHJF-1 (McDonnell) .. *(1949-50)* 248c
XHJP-1 (Piasecki) .. *(1949-50)* 266c
XHJS-1 (Sikorsky) .. *(1949-50)* 275c
XHR2S (Sikorsky) .. *(1954-55)* 294
XHRH (McDonnell) .. *(1953-54)* 253
XHSL-1 (Bell) .. *(1953-54)* 203
XL-25 (McDonnell) .. *(1953-54)* 253
XM-1000 (Molyneux) .. *(1957-58)* 117
XROE-1 (Hiller) 315
XRON-1 (Gyrodyne) 312
XV-1 (McDonnell) .. *(1957-58)* 331
XV-3 (Bell) 259

Y

YH-12 (Bell) .. .. *(1953-54)* 203
YH-13 (Bell) .. .. *(1951-52)* 201
YH-15 (Bell) .. .. *(1950-51)* 203c
YH-16 (Vertol) .. .. *(1956-57)* 346
YH-18 (Sikorsky) .. *(1953-54)* 274
YH-24 (Siebel) .. .. *(1953-54)* 273
YH-30 (McCulloch) .. *(1954-55)* 266
YH-31 (Doman) .. .. *(1955-56)* 246
YH-32 (Hiller) 315
YH-32A (ULV) (Hiller) 316
YHC-1 (Vertol) 385
YH-41 (Cessna) 276
YHO-2 (Hughes) 318
YHO-3 (Brantly) 271
YaK-24 (Yakoviev) 231
YAKOVLEV, A.S. (Russia) .. 231

Z

Zuk (Poland) 211
Zurakowski Helicopter (Poland) (1951-52) 167

JET ENGINES

PAGE

A

A 129 (Blackburn) 436
AJ10-24 (Aerojet) .. *(1957-58)* 432
ARS.600 Ramjet (Nord) .. *(1957-58)* 420
ASM Mamba (Armstrong Siddeley) *(1957-58)* 393
ASMD Double Mamba (Armstrong Siddeley) .. .. *(1957-58)* 393
ASSa (Armstrong Siddeley) .. *(1957-58)* 391
ASSc (Armstrong Siddeley) *(1957-58)* 395
ASV Viper (Armstrong Siddeley) *(1957-58)* 394
A.S.X. (Armstrong Siddeley) *(1949-50)* 8d
Adder (Armstrong Siddeley) *(1953-54)* 284
AEROJET-GENERAL CORPORATION (U.S.A.) 476
AEROPLANES G. VOISIN, GROUPE O (France) .. .. *(1950-51)* 18d
ALLISON DIVISION, GENERAL MOTORS CORPORATION (U.S.A.) 476
Arbizon (Turbomeca) 468
Arius (Turbomeca) .. *(1956-57)* 394
ARMSTRONG SIDDELEY MOTORS LTD. (G.B.) 431
ARSENAL DE L'AERONAUTIQUE (see S.F.E.C.M.A.S.) .. *(1954-55)* 326
Artouste (Blackburn) 437
Artouste (Turboméca) 469
Aspin (Turbomeca) .. *(1954-55)* 329
Astazou (Turbomeca) 469
ASTRODYNE INC. (U.S.A.) .. 479
Atar 8 (SNECMA) 465
Atar 9 (SNECMA) 465
Atar 101 (Voisin) .. *(1950-51)* 18d
Atar 101 (SNECMA) 466
Autan (Turbomeca) 470
Avon (Flygmotor) 475
Avon (Rolls-Royce) .. 453, 454
A. V. ROE CANADA LTD. (Canada) (see Orenda Engines, Ltd) .. *(1957-58)* 415

B

B.E.47 (Bristol) .. *(1957-58)* 397
BOl. Olympus (Bristol) .. *(1957-58)* 397
BOn. Orion (Bristol) .. *(1957-58)* 399
BOr. Orpheus (Bristol) .. *(1957-58)* 399
BRJ.5 Thor (Bristol) .. *(1957-58)* 402
BRJ-801 (Bristol) 443
BT Thor (Bristol) .. *(1957-58)* 402
Bastan (Turbomeca) 469
BE.25 (Bristol) .. *(1955-56)* 334
Black Knight (Armstrong Siddeley) .. 435
BLACKBURN & GENERAL AIRCRAFT, LTD. (G.B.) 435
BLACKBURN-TURBOMECA (see Blackburn & General Aircraft, Ltd.) 435
BMW STUDIENGESELLSCHAFT FUR TRIEBWERKSBAU G.m.b.H. (Germany) 471
BOEING AIRPLANE COMPANY, INDUSTRIAL PRODUCTS DIVISION (U.S.A.) 479
BRISTOL AERO-ENGINES, LTD. (G.B.) 438
BRISTOL AERO ENGINES LTD. (Canada) 459
BRISTOL AERO ENGINES (WESTERN) LTD. (Canada) .. 459
BRISTOL SIDDELEY ENGINES, LTD. (G.B.) 437
BRISTOL AEROPLANE CO., LTD. (G.B.) .. .. *(1955-56)* 311

C

C-20 (Marquardt) .. *(1954-55)* 340
CJ-805 (General Electric) .. *(1957-58)* 438
CJ-805-3 (General Electric) .. 483
CJ-805-21 (General Electric) .. 483
Chinook (Avro, Canada) .. *(1950-51)* 17d
Clyde (Rolls-Royce) .. *(1950-51)* 14d
CONTINENTAL AVIATION AND ENGINEERING CORP. (U.S.A.) .. 480
Conway (Rolls-Royce) 452
Coupled Naiad (Napier) .. *(1951-52)* 12
Coupled Proteus (Bristol) .. *(1952-53)* 254
Coupled-Turmo (Turbomeca) *(1956-57)* 369d

D

DGJ. Gyron Junior (D.H.) *(1957-58)* 402
DGy. Gyron (D.H.) .. *(1957-58)* 402
PAGE
D.H. (see de Havilland Engine Co. Ltd.) *(1957-58)* 402
DSpe Spectre (de Havilland) .. 447
DAIMLER-BENZ AKTIENGESELLSCHAFT (Germany) 471
Dart (Rolls-Royce) 456
DASSAULT, Général Aeronautique MARCEL (France) 462
DE HAVILLAND ENGINE CO., LTD. The (G.B.) 443
Derwent (Rolls-Royce) .. *(1956-57)* 382
Double Mamba (Armstrong Siddeley) 434
Double Sceptre (de Havilland) .. 447
Double Scorpion (Napier) 451
Double Naiad (Napier) .. *(1949-50)* 18d
Dovern (Stal) .. .. *(1955-56)* 357

E

Ecrivisse (SNECMA) .. *(1957-58)* 424
Eland (Napier) 449
Escopette (SNECMA) .. *(1957-58)* 424

F

F-2 (Metrovick) (1949-50) 16d
F-5 (Metrovick) .. .. *(1948)* 14d
FABRIQUE NATIONALE D'ARMES DE GUERRE (Belgium) .. 430
FN (see Fabrique, Nationale d'Armes de Guerre S.A.) 430
FAIRCHILD ENGINE DIVISION, FAIRCHILD ENGINE & AIR PLANE CORPN. (U.S.A.) .. 481
Farandole (Dassault) 462
FIAT SOCIETA PER AZIONI (Italy) 472
FLADER INC., FREDRIC (U.S.A.) *(1952-53)* 270
FLYGMOTOR (see Svenska Flygmotor A.B. (Sweden) 475
FUJI JUKOGYO K.K. (Japan) *(1957-58)* 429

G

Gabizo (Turbomeca) 468
Gazelle (Napier) 447
Gazelle Junior (Napier) 448
GENERAL ELECTRIC COMPANY, AIRCRAFT GAS TURBINE DIVISION (U.S.A.) 481
Ghost (Flygmotor) 475
Ghost (D.H.) 444
Ghost (Fiat) .. .. *(1957-58)* 428
Gnome (de Havilland) 445
Goblin (D.H.) 445
Gourdon (Turbomeca) 468
Guardian (RMI) 490
Gyron (D.H.) 444
Gyron Junior (D.H.) 443

H

HEINKEL A. G., ERNST .. 471
HILLER AIRCRAFT CORP. (U.S.A.) PROPULSION DEPT. .. 485
HILLER HELICOPTERS, RAMJET DIVISION (U.S.A.) .. *(1957-58)* 441
HISPANO-SUIZA, SOCIÉTÉ (France) 463

I

Iroquois (Orenda) 459
ISHIKAWAJIMA JUKOGYO K.K. (Japan) 474
Ivchenko (Soviet Union) 475

J

J3-1 (Nippon) 474
J-30 (Westinghouse) .. *(1948)* 71d
J-33 (Allison) 478
J-34 (Westinghouse) 492
J-35 (Allison) .. .. *(1957-58)* 434
J-40 (Westinghouse) .. *(1956-57)* 414
J-42 (Pratt & Whitney) .. *(1954-55)* 310
J-44 (Fairchild) 481
J-46 (Westinghouse) .. *(1957-58)* 448
J-47 (General Electric) 484
J-48 (Pratt & Whitney) 489
J-52 (Pratt & Whitney) 489
J-54 (Westinghouse) .. *(1957-58)* 447
J-55 (Flader) .. .. *(1952-53)* 270
PAGE
J-57 (Pratt & Whitney) 487
J-58 (Pratt & Whitney) 488
J65 (Wright) 493
J67 (Wright) .. .. *(1955-56)* 372
J.69 (Continental) 480
J-71 (Allison) 477
J-73 (General Electric) .. *(1957-58)* 440
J-75 (Pratt & Whitney 487
J79 (General Electric) 482
J85 (General Electric) 482
J93 (General Electric) 482
J.J.E. Models (Japan) .. *(1956-57)* 397
JO-1 (Fuji) .. .. *(1955-56)* 355
JO-1 (Nippon) 474
JT3 (Pratt & Whitney) 488
JT-3D (Pratt & Whitney) .. 489
JT4 (Pratt & Whitney) 487
JT-12 (Pratt & Whitney) 487
JAPAN JET-ENGINE CO. (Japan) *(1956-57)* 397
JATO (Aerojet) .. .. *(1956-57)* 400

K

K (Soviet Union) 475
KAWASAKI KOKUKI (Japan) *(1956-57)* 397

L

LR44-RM-2 (RMI) 490
LR2-RM-12 (RMI) .. *(1956-57)* 413
LR8-RM-6 (RMI) 491
LTC1 (Lycoming) 486
LTC4 (Lycoming) 486
LU-4 (Soviet Union) 475
Long-life Viper (Armstrong Siddeley) *(1956-57)* 367
LYCOMING DIVISION OF THE AVCO MANUFACTURING CORP. (U.S.A.) 486

M

M-Series (Soviet Union) .. *(1955-56)* 356
M-012 (Soviet Union) .. *(1955-56)* 356
M-018 (Soviet Union) .. *(1955-56)* 356
M-022 (Soviet Union) .. *(1955-56)* 356
M-028 (Soviet Union) .. *(1955-56)* 356
M.205 (Soviet Union) .. *(1956-57)* 398
M.209 (Soviet Union) 475
MA-19G (Marquardt) 487
MA-20C (Marquardt) 487
M.D. 30 Viper (Dassault) 462
Mamba (Armstrong Siddeley) .. 433
Marboré (Turboméca) 468
Marcadau (Blackburn) .. *(1957-58)* 369
Marcadau (Turbomeca) 468
MARQUARDT AIRCRAFT COMPANY (U.S.A.) 486
Mercury (Solar) .. .. *(1957-58)* 447
METROVICK (Metropolitan-Vickers Electrical Company Ltd.) (G.B.) *(1950-51)* 11d
Mikulin 205 (Soviet Union) *(1955-56)* 356
MITSUBISHI KOKUKI (Japan) *(1957-58)* 397
Model 2.5KS-18000 (Aerojet) .. 476
Model 5KS-4500 (Aerojet) 476
Model 8R.J2 (Hiller) .. *(1957-58)* 441
Model 8RJ2B (Hiller) 485
Model 12AS-8250B (Aerojet) *(1956-57)* 400
Model 14AS-1000 (Aerojet) *(1956-57)* 400
Model 15KS-1000 (Aerojet) .. 476
Model 15NS-250 476
Model 65 (SEPR) 464
Model 73 (SEPR) 464
Model 140 (Continental) .. *(1956-57)* 405
Model 141 (Continental) 480
Model 160 (Continental) .. *(1957-58)* 436
Model 210 (Continental) .. *(1957-58)* 436
Model 220 (Continental) 480
Model 320 (Continental) 480
Model 324 (Continental) 480
Model 352 (Continental) 480
Model 354 (Continental) 480
Model 481 (SEPR) 463
Model 500 Turbojet (Boeing) *(1955-56)* 362
Model 501 (Allison) 478
Model 502 Turboprop (Boeing) .. 479
Model 504 (SEPR) 464
Model 505 (SEPR) 464
Model 520-2 (Boeing) 479
Model 550 (Allison) 477
Model 660 (SEPR) 464

PAGE

Model 681 (SEPR) 464
Model 732 (SEPR) 464
Model 2020 (SEPR) 464
Model 4002 (Fiat) 473
Model 4032 (Fiat) 472
Model 4700 (Fiat) 472
Model 5051 (SEPR) 464
Model 5052 (SEPR) 464
Model 5053 (SEPR) 464
Model 50531 (SEPR) 464
Model 6000C4 (Reaction) .. *(1955-56)* 370
Model AJ10-24 (Aerojet) .. *(1956-57)* 400
Model AJ24-1 (Aerojet) .. *(1956-57)* 401
Model Tu205 (RMI) 490
Model YLR45-AJ-1 (Aerojet) *(1956-57)* 401
Model YLR-63-AJ-1 (Aerojet) *(1956-57)* 401

N

N.El.3 Eland (Napier) 450
NGa. Gazelle (Napier) .. *(1957-58)* 406
NK-4 (Soviet Union) 475
N.R.E.17 (Napier) 450
N.R.E.19 (Napier) 450
N.R.J.1 (Napier) 451
NSc. Double Scorpion (Napier) *(1957-58)* 409
Naiad (Napier) .. .. *(1951-52)* 13d
NAPIER & SON LIMITED (G.B.) 447
Nene (Rolls-Royce) .. *(1957-58)* 412
Nene (Hispano Suiza) .. *(1957-58)* 419
Nene 10 (Rolls-Royce Canada) *(1957-58)* 417
NIPPON JET-ENGINE COMPANY (Japan) 474
Nomad (Napier) .. *(1955-56)* 339
NORD, Société Nationale de Constructions Aéronautique du (France) *(1957-58)* 420
NORTHROP-HENDY COMPANY (1947) 58d

O

Olympus (Bristol) 438
ORENDA ENGINES LTD. (Canada) 459
Orenda (Orenda) 459
Orenda (Avro Canada) .. *(1954-55)* 322
Orion (Bristol) .. .. *(1957-58)* 399
Orpheus (Bristol) 439
Oryx (Napier) .. *(1956-57)* 377

P

P.181 (Armstrong Siddeley) .. 432
P.182 (Armstrong Siddeley) .. 432
PR-23 (Armstrong Siddeley) .. 435
PT2F (Pratt & Whitney) .. *(1953-54)* 309
Palas 600 (Blackburn) 435
Palas (Turboméca) 467
Palouste 500 (Blackburn) 437
Palouste (Turboméca) 469
Patriot (RMI) 490
Pimene (Turboméca) .. *(1952-53)* 264
Pioneer (RMI) 490
POWER JETS RESEARCH & DEVELOPMENT LTD. (1949-50) 18d
PRATT & WHITNEY AIRCRAFT DIVISION OF UNITED AIRCRAFT CORPORATION (U.S.A.) .. 487
Proteus (Bristol) .. *(1957-58)* 400
Proteus 250 (Bristol) 442
Proteus 700 (Bristol) 440
Proteus 750 (Bristol) 441
Proteus 760 (Bristol) 442
Pulse-jets (SNECMA) 467
Pulse-jet (Saro) .. .. *(1955-56)* 344
Pulse-jet (S.N.C.A.N.) .. *(1955-56)* 350
Python (Armstrong Siddeley) *(1955-56)* 327

R

R.7 (Dassault) 462
R-300 (Hispano-Suiza) .. *(1953-54)* 295
R-450 (Hispano-Suiza) .. *(1953-54)* 295
R.800 (Hispano-Suiza) .. *(1956-57)* 388
R.804 (Hispano-Suiza) 463
R.854 (Hispano-Suiza) 463
RA Series (Rolls-Royce) .. *(1957-58)* 411
RB.108 (Rolls-Royce) 453
RB.141 (Rolls-Royce) 453
RB.145 (Rolls-Royce) 453
RD-3 (Soviet Union) 475

PAGE

RD-45 (Soviet Union) 475
RD-500 (Soviet Union) 475
RDa. Series (Rolls-Royce) .. *(1957-58)* 412
RJ-30-MA-6 (Marquardt) 487
RJ43 (Marquardt) 487
RJ57 (Marquardt) 487
RJ59 (Marquardt) 487
RM1 (see Reaction Motors, Inc.) .. 490
RM2 Ghost (Flygmotor) 475
RM2B Ghost (Flygmotor) .. 475
RM5 Avon (Flygmotor) 475
RM6 Avon (Flygmotor) 475
RN Series (Rolls-Royce) .. *(1957-58)* 412
ROR System (RM1) .. *(1957-58)* 446
Ramjet (Hiller) 485
Ramjet (Marquardt) 442
Ramjet (Napier) 451
Ramjet (S.N.C.A.N.) .. *(1957-58)* 390
RATEAU, SOCIÉTÉ (France) *(1957-58)* 390
REACTION MOTORS INC. (U.S.A.) .. 490
Raven (Bristol) 443
Rocket (Napier) .. .. *(1957-58)* 379
ROCKETDYNE DIVISION OF NORTH AMERICAN AVIATION, INC. (U.S.A.) 491
ROLLS-ROYCE LIMITED (G.B.) .. 451
ROLLS-ROYCE OF CANADA LTD. .. 461

S

Sapphire 100 (Armstrong Siddeley) .. 431
Sapphire 200 (Armstrong Siddeley) .. 432
SAUNDERS-ROE, LTD. (G.B.) *(1955-56)* 344
Savoie (Rateau) .. .. *(1955-56)* 349
Screamer (Armstrong Siddeley) *(1957-58)* 395
Scorpion (Napier) 451
SEPR (Société d'étude de la Propulsion par Réaction) (France) 463
SEPR 25 .. .. *(1957-58)* 420
SEPR 65 464
SEPR 66 .. .. *(1957-58)* 421
SEPR 78 .. .. *(1957-58)* 421
SEPR 251 .. .. *(1957-58)* 420
SEPR 481 463
SEPR 631 .. .. *(1957-58)* 421
SEPR 660 464
SEPR 732 .. .. *(1957-58)* 421
SEPR 2020 464
SEPR 5053 .. .. *(1957-58)* 421
SEPR 5054 .. .. *(1957-58)* 421
S.F.E.C.M.A.S. (Société Francaise d'Etudes et de Constructions de Materiels Aeronautiques speciaux) (France) (see S.N.C.A.N.) *(1955-56)* 349
Short-life Viper (Armstrong Siddeley) *(1956-57)* 366
Snarler (Armstrong Siddeley) *(1955-56)* 329
S.N.C.A.N. (Société National de Constructions Aéronautiques du Nord) (France) .. .. *(1956-57)* 90
SNECMA (Société Nationale d'Etude et de Construction de Moteurs d'Aviation) (France) 464
Soar (Rolls-Royce) .. *(1957-58)* 410
SOCEMA (Société de Construction et d'Equipments Mecaniques Pour l'Aviation) (France) .. *(1950-51)* 19d
SOLAR AIRCRAFT COMPANY (U.S.A.) 491
Soulor (Turbomeca) .. *(1957-58)* 425
Spectre (D.H.) 446
Sprite (D.H.) .. .. *(1954-55)* 315
SRA-1 (Rateau) .. .. *(1948)* 46d
SRA-101 (Rateau) .. *(1955-56)* 349
ST.450 (Nord) .. .. *(1957-58)* 420
STAL (see Svenska Turbinfabriks Ab Ljungstrom (Sweden) .. *(1957-58)* 431
SUD-OUEST, Société Nationale de Constructions Aeronautiques de, (France) .. .. *(1954-55)* 328
Super Sprite (D.H.) 446
SVENSKA FLYGMOTOR A.B. (Sweden) 475
SVENSKA TURBINFABRIKS AB LJUNGSTROM (Sweden) *(1957-58)* 431

T

T-31 (General Electric) .. *(1949-50)* 30d
T-34 (Pratt & Whitney) 489
T-38 (Allison) .. .. *(1954-55)* 334
T40 (Allison) .. .. *(1957-58)* 434

PAGE

T49 (Wright) .. .. *(1957-58)* 450
T50 (Boeing) .. .. *(1955-56)* 362
T53 (Lycoming) 486
T55 (Lycoming) 486
T56 (Allison) 477
T57 (Pratt & Whitney) .. *(1957-58)* 444
T58 (General Electric) 483
T60 (Boeing) 479
T64 (General Electric) 483
TB. 1000 (SNECMA) .. *(1952-53)* 262
TGA-1 (SOCEMA) .. *(1950-51)* 19d
TGAR-1008 (SOCEMA) .. *(1950-51)* 20d
TJ-37 (Wright) 493
TJ-38 Zephyr (Wright) 492
TP51J2 (Wright) .. *(1957-58)* 450
Tay (Rolls-Royce) .. *(1956-57)* 333
Tay (Hispano-Suiza) .. *(1957-58)* 390
Theseus (Bristol) .. *(1951-52)* 7d
Thor (Bristol) 442
Thrust Reverser (SNECMA) *(1955-56)* 351
Titan (Solar) 491
Tramontane (Turbomeca) 470
Trent (Rolls-Royce) .. *(1948)* 18d
Tromblon (SNECMA) .. *(1954-55)* 297
TUCKER INDUSTRIES INC. (U.S.A.) .. .. *(1948)* 71d
TURBODYNE CORPORATION, THE (U.S.A.) .. *(1950-51)* 29d
TURBOMÉCA, SOCIÉTÉ (France) .. 467
Turbo-Wasp (Pratt & Whitney) *(1954-55)* 340
Turmo 600 (Blackburn) 436
Turmo (Turbomeca) 469
Two-Dimensional Ramjet (Marquardt) *(1957-58)* 442
Tyne (Rolls-Royce) 455
Type O14 (East Germany) 471
Type 022 (Soviet Union) 475

V

VK-1 (Soviet Union) 475
VK-5 (Soviet Union) 475
Verdon (Hispano-Suiza) 463
VERWALTUNG DER LUFTFAHRT-INDUSTRIE (East Germany) .. 471
Vesta (SNECMA) .. *(1956-57)* 391
Viper (Armstrong Siddeley) .. 434
Viper (Dassault) 462
Vulcain (SNECMA) .. *(1955-56)* 350

W

WEST ENGINEERING COMPANY INC. (U.S.A.) .. *(1948)* 71d
WESTINGHOUSE ELECTRIC CORPORATION, AVIATION GAS TURBINE DIVISION (U.S.A.) .. 491
WOJCICKI (Poland) 474
WRIGHT AERONAUTICAL DIVISION, CURTISS-WRIGHT CORPORATION (U.S.A.) 492

X

X-84 (General Electric) .. *(1956-57)* 407
X405 (General Electric) 485
XJ81 (Westinghouse) 492
XJ83 (Fairchild) 481
XJ85 (General Electric) .. *(1957-58)* 438
XLR10-RM-2 (RMI) 490
XLR25 (Curtiss-Wright) 493
XLR25-W-1 (Wright) 450
XJ85 (General Electric) .. *(1957-58)* 438
XT-38 (Allison) .. .. *(1950-51)* 22d
XT-40 (Allison) .. .. *(1950-51)* 23d
XT51 (Continental) 480
XT58 (G.E.) .. .. *(1955-56)* 364

Y

YJ-44 (Fairchild) .. *(1952-53)* 270
YT 50 (Boeing) .. .. *(1955 56)* 337
YT-62 (Solar) 491
YT-66 (Solar) 491

Z

Zephyr (Bristol) 439
Zephyr (Wright) 492
Zubets (Soviet Union) 475

PISTON ENGINES

PAGE

A

A-1 Alcion (E.N.M.A.) .. *(1957-58)* 471
A-65 (Continental) 516
A.B.C. MOTORS LIMITED (G.B.) *(1949-50)* 36d
AI-4G (Russia) 512
AI-14R (Russia) 512
AI-26B (Russia) 512
ASh-82T (Russia) 512
AERONAUTICA MACCHI (Italy) *(1949-50)* 70d
AGUSTA, MECCANICA VERGHERA (Italy) 510
AIRCOOLED MOTORS INC. (U.S.A.) 518
Alcion (E.N.M.A.) 514
ALFA ROMEO, SOCIETA PER AZIONI (Italy) 511
ALVIS LIMITED (G.B.) 491
AM Series (Soviet Union) .. *(1951-52)* 61d
AMBROSINI & C. SOCIETA AERONAUTICA ITALIANA (Italy) .. .. *(1952-53)* 295
ANDREWS-CAMERON MANUFACTURING CO. (U.S.A.) *(1951-52)* 66d
Ardem 4 CO2 (Druine) 506
ARMSTRONG SIDDELEY MOTORS LTD. (G.B.) .. .. *(1952-53)* 277
ARSENAL DE L'AÉRONAUTIQUE (see S.F.E.C.M.A.S.) (France) *(1955-56)* 329
ASh Series (Soviet Union) .. 512
Asso 6 (Isotta Fraschini) .. *(1951-52)* 60d
Avia Ceskoslovenske Zavody) (1948) 37d
Avro Canada (A. V. Roe Canada Ltd.) *(1952-53)* 261

B

B-4 Beta (E.N.M.A.) .. *(1957-58)* 470
B5 and B54 (Kinner) .. *(1950-51)* 71d
BMW STUDIENGESELLSCHAFT FUR TRIEBWERKSBAU G.m.b.H. (Germany) .. *(1957-58)* 466
BARMOTIVE PRODUCTS, INC. (U.S.A.) 523
BEARN (see Société de Construction d'Exploitation de Materiels et de Moteurs (S.C.E.M.M.) (France) *(1949-50)* 59d
Beta B-4 (E.N.M.A.) 513
Bombardier (Cirrus) 499
BRISTOL AERO-ENGINES, LTD (G.B.) 496
BRISTOL AEROPLANE COMPANY LTD., The (G.B.) .. *(1955-56)* 346

C

C4-1-E1 (Andrews-Cameron) *(1951-52)* 66d
C75 (Continental) .. *(1952-53)* 299
C85 (Continental) 516
C90 (Continental) 516
C115 (Continental) .. *(1950-51)* 68d
C125 (Continental) .. *(1953-54)* 299
C145 (Continental) .. *(1655-59)* 394
Centaurus (Bristol) 496
CESKOSLOVENSKÉ ZÁVODY LETECKE (Czechoslovakia) .. 504
Cheetah I Armstrong Siddeley) *(1951-52)* 35d
Cicada (Commonwealth) .. *(1955-56)* 356
CIRRUS ENGINE DIVISION OF BLACKBURN & GENERAL AIRCRAFT LTD. (G.B.) 499
Cirrus Major (Cirrus) .. *(1956-57)* 424
Cirrus Minor (Cirrus) .. *(1956-57)* 424
C.N.A. CONSTRUZIONI NAZIONALI AERONAUTIQUE (1950-51) 60d
COMMONWEALTH AIRCRAFT CORPORATION PTY. LTD. (Australia) .. .. *(1955-56)* 356
CONTINENTAL MOTORS CORPORATION, AIRCRAFT ENGINE DIVISION (U.S.A.) 516
COVENTRY VICTOR MOTOR CO. LTD. (G.B.) 500
Cyclone 7 (Lycoming Wright) *(1955-56)* 399
Cyclone 9 (Lycoming Wright) *(1955-56)* 399
Cyclone 18 (Wright) 525
Cypselus (Isotta Fraschini) .. *(1951-52)* 60d
Czechoslovak Aircraft Works (Czechoslovakia) 504

D

D-4 (C.N.A. .. .. *(1950-51)* 60d
DAIMLER-BENZ AKTIENGESELLSCHAFT (Germany) .. *(1956-57)* 433

PAGE

DE HAVILLAND ENGINE COMPANY LTD., The (G.B.) .. 500
Delta (Isotta Fraschini) .. *(1951-52)* 60d
Doris B (Czechoslovakia) .. *(1957-58)* 462
Double-Wasp (Pratt & Whitney) .. 524
DRUINE, AVIONS ROGER (France) 506

E

E185 and E255 (Continental) *(1956-57)* 439
E165 (Continental) .. *(1952-53)* 299
E.N.M.A. (Empresa Nacional de Motores de Aviacion S.A.) 513
Eagle (Rolls-Royce) .. *(1950-51)* 41d
El Gaucho (Instituto Aerotecnico) *(1951-52)* 33d
El Indio (Instituto Aerotecnico) *(1951-52)* 33d
ELIZALDE S.A. (see E.N.M.A.) (Spain) .. .. *(1955-56)* 392
EMPRESA NACIONAL DE MOTORES DE AVIACION S.A. (Spain) .. 513

F

F-IV-1 (E.N.M.A.) 514
FSO-470 (Continental) .. *(1957-58)* 439
FSO-526 (Continental) 518
FAIRCHILD ENGINE DIVISION, FAIRCHILD ENGINE & AIRPLANE CORPN. (U.S.A.) *(1951-52)* 67d
FIAT (see Societa per Azioni Fiat Sezione Linaotto (Italy) .. *(1952-53)* 296
Flecha (E.N.M.A.) 514
FLUGZEUGTRIEBWERKS-INDUSTRIE DER DEUTSCHEN DEMOKRATISCHENREPUBLIK (East Germany) .. *(1957-58)* 466
Flygmotor F-451-A (Svenska) *(1951-52)* 65d
Flying Neptune (Coventry Victor) .. 500
FRANKLIN (see Aircooled Motors Inc.) (U.S.A.) 518
Franklin 335 518
Franklin 335 Vertical 518

G

G-2F (Mathis) .. .. *(1949-50)* 60d
G-4F (Mathis) .. .. *(1949-50)* 60d
G-4 and G-4R (Mathis) .. *(1949-50)* 61d
G-7 and G-7R (Mathis) .. *(1949-50)* 61d
G-8 and G-8R (Mathis) .. *(1949-50)* 61d
G-14R and G-14RS (Mathis) *(1949-50)* 61d
G-IV Tigre (E.N.M.A.) 514
G.A.40 (Agusta) 510
G.A.70/O (Agusta) 510
G.A.70/V (Agusta) 510
GO-300 (Continental) 516
GO-315 (Continental) 516
GO-315-A (Continental) .. *(1957-58)* 472
GO-435 (Lycoming) .. *(1957-58)* 476
GO-480 (Lycoming) .. *(1957-58)* 476
Griffon (Rolls-Royce) .. *(1955-56)* 383
GSO-480 (Lycoming) .. *(1957-58)* 476
GSO-526 (Continental) 518
GSO-580 (Lycoming) 521
Gipsy Queen (D.H.) 500
Gipsy Major (D.H.) 501
Gipsy Major 10 (de Havilland) .. 501
Gipsy Major 200 (de Havilland) .. 501
Gipsy Major 215 (de Havilland) .. 502
Gnome-Rhone series (Snecma) *(1950-51)* 56d
Gypagus (Isotta-Franschini) *(1951-52)* 60d

H

H-59 (Nelson) .. .. *(1956-57)* 455
H-63 (Barmotive) 523
HEINKEL, A. G. ERNST (Germany) 466
Helicoptere (SNECMA) .. *(1955-56)* 389
Hercules (Bristol) 497
HERMANN ENGINEERING COMPANY (U.S.A.) .. *(1950-51)* 69d
HISPANO-SUIZA SOCIETE (France) *(1951-52)* 52d
Horus 4 (Minie) .. .. *(1948)* 52d

I

IO-170 (Continental) 518
INSTITUTO AEROTECNICO (Argentine) .. .. *(1951-52)* 33d
ISOTTO-FRASCHINI, FABRICA AUTOMOBILI (Itay) .. *(1953-54)* 334
IVCHENKO, A. (Russia) 512

PAGE

J

JACOBS AIRCRAFT ENGINE COMPANY (U.S.A.) .. *(1956-57)* 440
JAMESON AERO ENGINES LTD. (G.B.) .. .. *(1949-50)* 46d
Jameson FF. .. .. *(1949-50)* 46d

K

K.5 (Kinner) .. .. *(1950-51)* 71d
KINNER GLADDEN PRODUCTS CORPN. (Formerly Kinner Motors Inc.) .. .. *(1951-52)* 70d

L

Leonides (Alvis) 494
Leonides Helicopter Engine (Alvis) .. 495
Leonides Major (Alvis) 495
Leonides Major Helicopter (Alvis) .. 496
LUTITIA, MOTEURS (France) *(1953-54)* 327
LYCOMING DIVISION OF THE AVCO MANUFACTURING CORPN. (U.S.A.) 518

M

M332 (Czechoslovakia) .. *(1957-58)* *461*
M Series (Soviet Union) .. *(1951-52)* 62d
MACCHI (see Aeronautica Macchi) (Italy) .. .. *(1949-50)* 70d
McCULLOCH MOTORS CORPORATION (U.S.A.) 521
MATHIS (see Société Mecamat) (France) *(1951-52)* 52d
Merlin (Rolls-Royce) .. *(1955-56)* 384
MINIÉ (Victor Minié Aeronautique) *(1953-54)* 327
Minor 4-III (Czechoslovakia) *(1957-58)* 461
Minor 6-III (Czechoslovakia) .. 505
Minor M332 (Czechoslovakia) .. 504
Minor M337 (Czechoslavakia) .. 505
Minor Sc (Czechoslovakia) .. *(1957-58)* 461
Model 4-D 00 (Potez) 506
Model 4 CO2 (Druine) 506
Model 4-D 02 (Potez) .. *(1957-58)* 463
Model 4-D 30 (Potez) .. *(1957-58)* 463
Model 6-D 02 (Potez) .. *(1957-58)* 463
Model 6-D 30 (Potez) .. *(1957-58)* 464
Model 8-D 30 (Potez) .. *(1957-58)* 464
Model 8-D 32 (Potez) .. *(1957-58)* 464
Model 335 (Franklin) .. *(1957-58)* 474
Model 335 Vertical (Franklin) *(1957-58)* 474
Model 425 (Franklin) .. *(1957-58)* 474
Model 678/0 (Porsche) 509
Model 678/1 (Porsche) 509
Model 678/3 (Porsche) 509
Model 4318A (McCulloch) 522
Model 6318 (McCulloch) 522
MONACO ENGINES LTD. (G.B.) *(1948)* 31d
MORRIS MOTORS LTD. (ENGINES BRANCH) .. *(1948)* 33d
MOTOKOV (Czechoslovakia) 428

N

NAPIER, D. & SON LTD. (G.B.) *(1952-53)* 284
NARKIEWICZ, DIPL. ING, WIKTOR (Poland) 511
Nelson H-63 (Barmotive) .. *(1957-58)* 478
NELSON (see Barmotive Products, Inc. 523
NUFFIELD (see Morris Motors Ltd. Engines Branch) (G.B.) .. *(1948)* 33d

O

O-100 (McCulloch) 521
O-145 (Lycoming) .. *(1952-53)* 301
O-150 (McCulloch) 522
O-235 (Lycoming) 518
O-240 (Jacobs) .. .. *(1950-51)* 71d
O-290 (Lycoming) 518
O-300 (Continental) 516
O-315 (Continental) .. *(1953-54)* 441
O-320 (Lycoming) 519
O-340 (Lycoming) 519
O-360 (Jacobs) .. .. *(1949-50)* 79d
O-360 (Lycoming) 519

PAGE

O-435 (Lycoming) 519
O-470 (Continental) 517
O-470-2 (Continental) 518
O-480 (Lycoming) 521
O-540 (Lycoming) 521
OMNIPOL LTD. (Czechoslovakia) .. 504

P

P.25 (*Ambrosini*) .. .. (*1952-53*) 296
P.70 (*Ambrosini*) .. .. (*1952-53*) 245
PIAGGIO & C. SOCIETA PER AZIONE (*Italy*) .. (*1949-50*) 70d
PORSCHE K G (Germany) .. 509
POTEZ, SOCIÉTÉ DES AVIONS ET MOTEURS (France) 506
Praga (*Czechoslovakia*) .. (*1951-52*) 49d
Praga Doris B (Czechoslovakia) .. 505
PRATT & WHITNEY AIRCRAFT DIVISION OF UNITED AIRCRAFT CORPN. (U.S.A.) .. 523

R

R-5 (*Kinner*) .. .. (*1950-51*) 71d
R-53 (*Kinner*) .. .. (*1950-51*) 71d
R-56 (*Kinner*) .. .. (*1951-52*) 70d
R-210 (*SNECMA*) .. (*1953-54*) 330
R-500 (*Warner*) .. .. (*1950-51*) 81d
R-550 (*Warner*) .. .. (*1950-51*) 81d
R-755 (*Jacobs*) .. .. (*1957-58*) 440
R-915 (*Jacobs*) .. .. (*1951-52*) 69d
R-985 (*Pratt & Whitney*) .. (*1952-53*) 303
R-1300 (*Lycoming Wright*) .. (*1955-56*) 399
R-1340 (*Pratt & Whitney*) .. (*1952-53*) 304
R-1820 (*Lycoming Wright*) .. (*1955-56*) 396
R-1830 (*Pratt & Whitney*) .. (*1951-52*) 74d
R-2000 Twin Wasp (Pratt & Whitney) 523
R-2180 (*Pratt & Whitney*) .. (*1950-51*) 78d
R-2600 (*Wright*) .. (*1948*) 91d
R-2800 Double Wasp (Pratt & Whitney) 524
R-3350 (Wright) 525
R-4360 Wasp Major (*Pratt & Whitney*) (*1957-58*) 480
RANGER AIRCRAFT ENGINES, DIVISION OF THE FAIRCHILD ENGINE & AIRCRAFT CORPN. (*U.S.A.*) .. (*1948*) 87d
REGNIER (*Société Anonyme des Etablissements Emile Regnier*) (*France*) .. .. (*1948*) 54d

PAGE

Regnier (*SNECMA*) .. (*1956-57*) 432
Renault 12T (SNECMA) 508
ROLLASON AIRCRAFT & ENGINES LTD. (G.B.) 503
ROLLS-ROYCE LIMITED (G.B.) .. 503

S

S-VII Sirio (*E.N.M.A.*) .. (*1957-58*) 470
SGV-770 (*Ranger*) .. (*1948*) 88d
SO-470 (*Continental*) .. (*1955-56*) 366
SO-480 (*Lycoming*) .. (*1957-58*) 476
SO-580 (*Lycoming*) .. (*1957-58*) 476
Sabre (*Napier*) .. .. (*1949-50*) 47d
SALMSON, SOCIÉTÉ DES MOTEURS (*France*) .. (*1955-56*) 320
S.F.E.C.M.A.S. (*France*) .. (*1954-55*) 359
SHVETSOV, A. D. (Russia) .. 512
Sirio S-VII 2 (E.N.M.A.) 513
SNECMA (see Société Nationale d'Etude et de Construction de Moteurs d'Aviation) (France) 508
SOCIETA PER AZIONE FIAT-SEZIONE LINGOTTO (*Italy*) (*1952-53*) 296
SOCIÉTE ANONYME DES ETABLISSEMENTS EMILE REGNIER (*France*) .. .. (*1948*) 54d
SOCIÉTÉ DE CONSTRUCTION ET D'EXPLOITATION DE MATERIELS ET DE MOTEURS (*S.C.E.M.M.*) (*France*) .. (*1949-50*) 59d
SOCIÉTÉ FRANCAIS D'ETUDES ET DE CONSTRUCTIONS DE MATERIELS AERONAUTIQUE SPECIAUX (*France*) .. *1954-55*) 359
SOCIÉTÉ MECAMAT (*France*) (*1951-52*) 52d
SOCIÉTÉ NATIONALE D'ETUDE ET DE CONSTRUCTION DE MOTEURS D'AVIATION (France) 508
SOVIET UNION, The .. (*1957-58*) 469
SVENSKA FLYGMOTOR A-B (*Sweden*) .. .. (*1951-52*) 65d

T

TC18 (Wright) 526
TC6150 (McCulloch) 522
Tigre G-IV (E.N.M.A.) 514
Tigre F-IV-35 (*E.N.M.A.*) (*1956-57*) 437

PAGE

Turbo-Compound (Wright) .. 526
Turbo-Cylone 9 (*Wright*) .. (*1950-51*) 84d
Turbo-Cyclone 18 (*Wright*) .. (*1953-54*) 347
Twin-Wasp (Pratt & Whitney) .. 523
Type 2 (*A.B.C.*) .. (*1949-50*) 36d
Type 10 (*A.B.C.*) .. (*1949-50*) 36d
Type 678/1 (*Porsche*) .. (*1957-58*) *466*

V

VK. Series (*Soviet Union*) .. (*1951-52*) 62d
VO-435 (*Lycoming*) .. (*1957-58*) 476
VEREINEGUNG VOLKSEIGENER BETRIEBE FLUGZEUGBAU (East Germany) 509
VSO-580 (*Lycoming*) .. (*1957-58*) 476
VICTOR MINIÉ AERONAUTIQUE (*France*) .. .. (*1953-54*) 327

W

WN-1 (Poland) 511
WN-2 (Poland) 511
WN-3 (Poland) 511
WN-3 (*Narkiewicz*) .. (*1957-58*) 468
WN-6 (Poland) 512
WN-6R (Poland) 512
WN-7 (Poland) 512
WN-7R (Poland) 512
Walter A (*Czechoslovakia*) .. (*1948*) 43d
Walter Minor 4-III (Czechoslovakia) .. 504
Walter Minor 6-III (*Czechoslovakia*) (*1957-58*) 462
Walter Minor Sc. (Czechoslovakia) .. 504
Walter Mikron III (*Czechoslovakia*) (*1956-57*) 428
WARNER DIVISION CLINTON MACHINE CO. (*U.S.A.*) (*1951-52*) 77d
Wasp (*Pratt & Whitney*) .. (*1952-53*) 304
Wasp Junior (*Pratt & Whitney*) (*1952-53*) 303
Wasp Major (*Pratt & Whitney*) (*1957-58*) 480
Wasp Senior (*Pratt & Whitney*) (*1952-53*) 306
WRIGHT AERONAUTICAL DIVISION, CURTISS-WRIGHT CORPORATION (U.S.A.) 525

Y

YO-100 (McCulloch) 522

THE NATIONAL MARKINGS OF THE AIR FORCES OF THE WORLD

ARRANGED IN

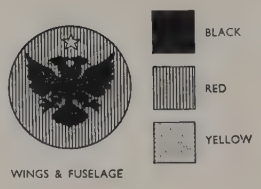
ALPHABETICAL ORDER OF NATIONS

AFGHANISTAN



THE ROYAL AFGHAN AIR FORCE

ALBANIA



THE ALBANIAN AIR FORCE

ARGENTINE REPUBLIC



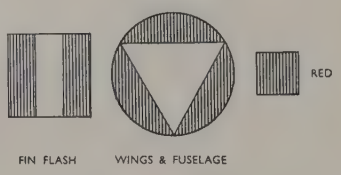
THE ARGENTINE AIR FORCE AND NAVAL AVIATION

AUSTRALIA



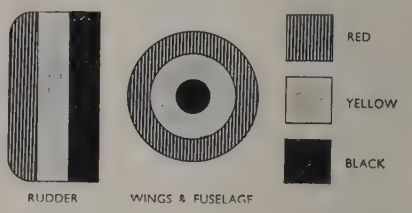
THE ROYAL AUSTRALIAN AIR FORCE

AUSTRIA



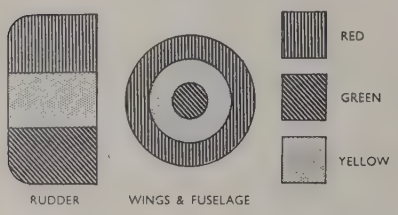
THE AUSTRIAN AIR FORCE

BELGIUM



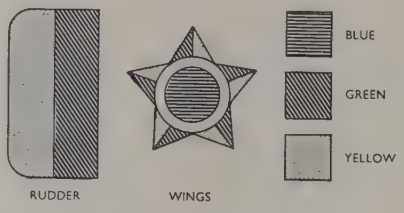
THE ROYAL BELGIAN AIR FORCE

BOLIVIA



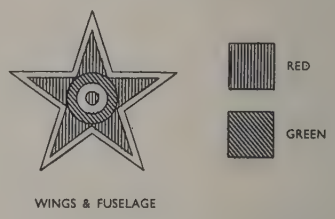
THE BOLIVIAN AIR FORCE

BRAZIL



THE BRAZILIAN AIR FORCE

BULGARIA



THE BULGARIAN AIR FORCE

BURMA



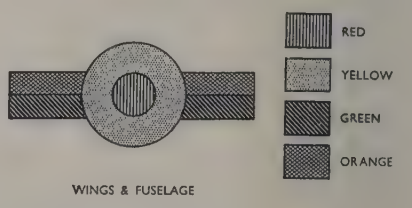
THE BURMA AIR FORCE

CANADA



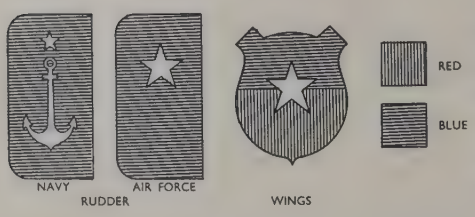
THE ROYAL CANADIAN AIR FORCE AND NAVAL AVIATION

CEYLON



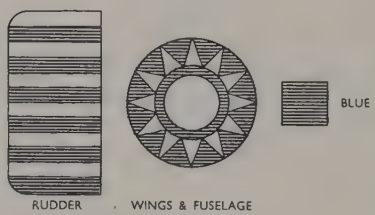
THE CEYLON AIR FORCE

CHILE



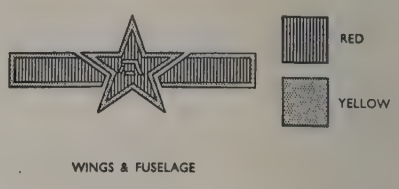
THE CHILEAN AIR FORCE and NAVAL AVIATION

CHINA
(NATIONALIST)



THE CHINESE NATIONALIST AIR FORCE

CHINA
(THE PEOPLE'S REPUBLIC)



THE CHINESE PEOPLE'S AIR FORCE

COLOMBIA



THE COLOMBIAN AIR FORCE

CUBA



THE CUBAN AIR CORPS

CZECHOSLOVAKIA



THE CZECHOSLOVAK AIR FORCE

DENMARK



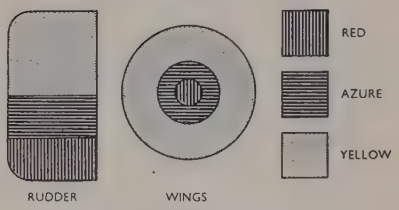
THE ROYAL DANISH AIR FORCE

DOMINICAN REPUBLIC



THE DOMINICAN AIR FORCE

ECUADOR



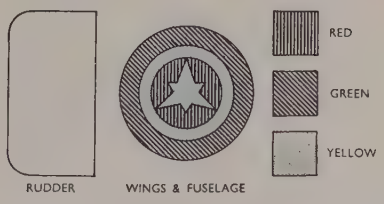
THE ECUADOREAN AIR FORCE

EGYPT
(UNITED ARAB REPUBLIC)



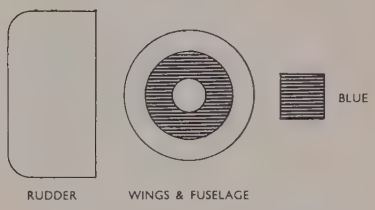
THE EGYPTIAN AIR FORCE

ETHIOPIA



THE IMPERIAL ETHIOPIAN AIR FORCE

FINLAND



THE FINNISH AIR FORCE

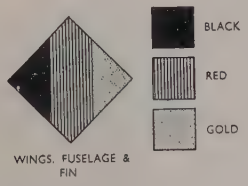
FRANCE



(Naval Aircraft have Black Anchor superimposed)

THE FRENCH AIR FORCE
AND NAVAL AVIATION

GERMAN DEMOCRATIC REPUBLIC



THE GERMAN AIR FORCE

GERMAN FEDERAL REPUBLIC



THE GERMAN AIR FORCE

GREAT BRITAIN



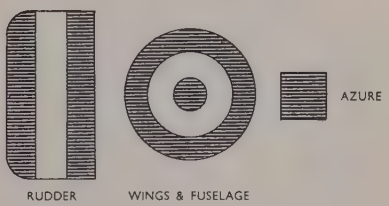
THE ROYAL AIR FORCE
AND FLEET AIR ARM

GUATEMALA



THE GUATEMALAN AIR FORCE

GREECE



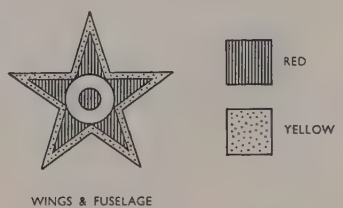
THE ROYAL HELLENIC AIR FORCE

HAITI



CORPS D'AVIATION D'HAITI

HUNGARY



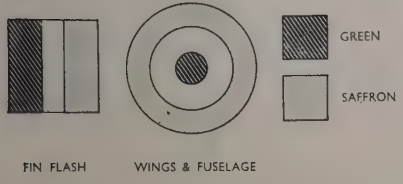
THE HUNGARIAN AIR FORCE

HONDURAS



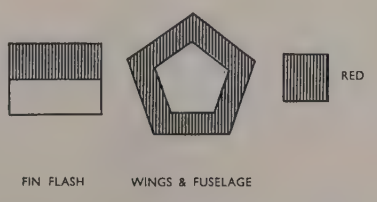
THE HONDURAS MILITARY AIR ARM

INDIA



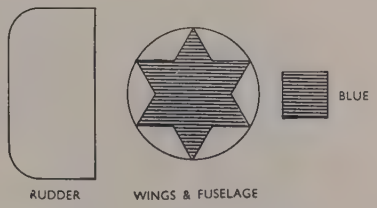
THE INDIAN AIR FORCE

INDONESIA



THE INDONESIAN AIR FORCE

ISRAEL



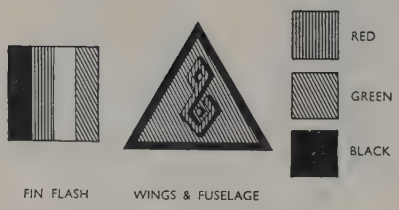
THE ISRAEL AIR FORCE

IRAN



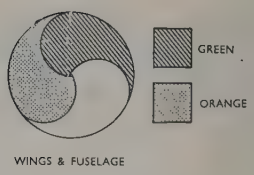
THE IMPERIAL IRANIAN AIR FORCE

IRAQ



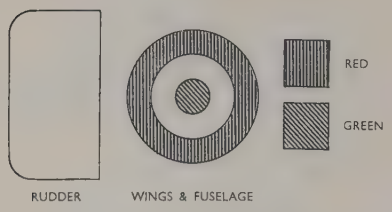
THE IRAQI AIR FORCE

IRELAND



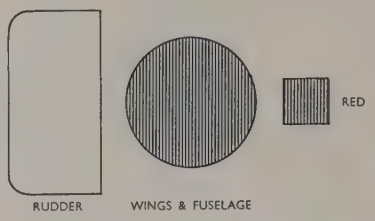
THE IRISH AIR CORPS

ITALY



THE ITALIAN AIR FORCE

JAPAN



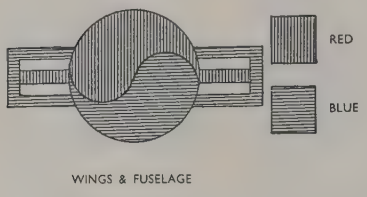
THE JAPANESE DEFENCE FORCES

JORDAN



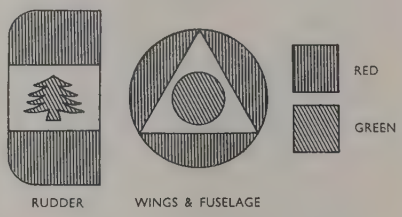
THE ROYAL JORDANIAN AIR FORCE

KOREA



THE REPUBLIC OF KOREA AIR FORCE

LEBANON



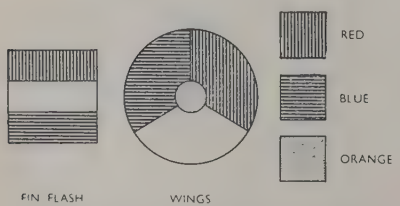
THE LEBANESE AIR FORCE

MEXICO



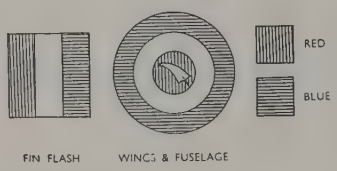
THE MEXICAN AIR FORCE

NETHERLANDS



THE ROYAL NETHERLANDS AIR FORCE

NEW ZEALAND



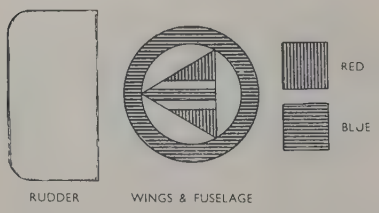
THE ROYAL NEW ZEALAND AIR FORCE

NICARAGUA



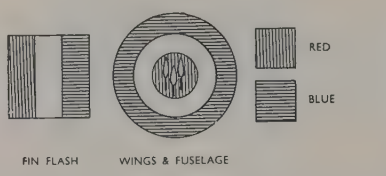
THE NICARAGUAN ARMY AIR FORCE

NORWAY



THE ROYAL NORWEGIAN AIR FORCE

RHODESIA & NYASALAND



THE ROYAL RHODESIAN AIR FORCE

PAKISTAN



THE PAKISTAN AIR FORCE

PERU



THE PERUVIAN AIR FORCE

PARAGUAY



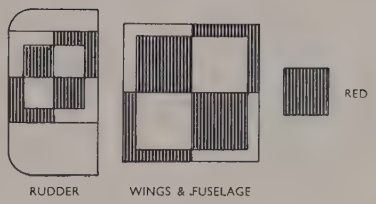
THE PARAGUAYAN AIR FORCE

PHILIPPINE REPUBLIC



THE PHILIPPINE AIR FORCE

POLAND



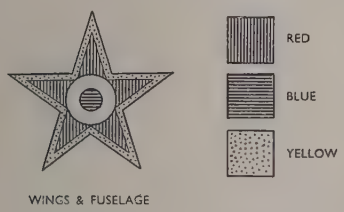
THE POLISH AIR FORCE

PORTUGAL



THE PORTUGUESE AIR ARM

RUMANIA



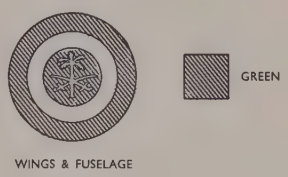
THE RUMANIAN AIR FORCE

SALVADOR



THE MILITARY AIR ARM

SAUDI ARABIA



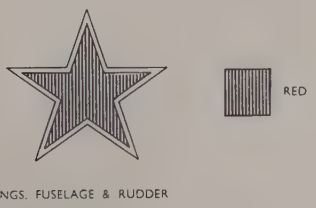
THE SAUDI ARABIAN AIR FORCE

SOUTH AFRICA



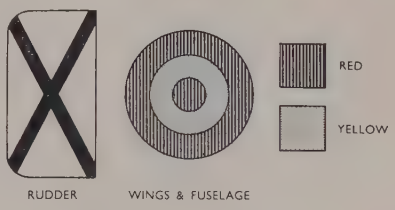
THE SOUTH AFRICAN AIR FORCE

SOVIET UNION



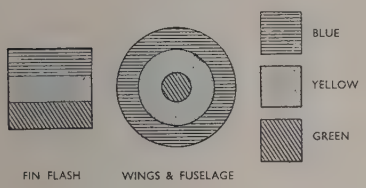
THE RUSSIAN AIR FORCE

SPAIN



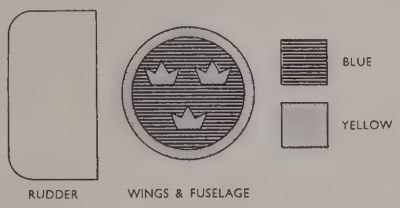
THE SPANISH AIR FORCE

SUDAN



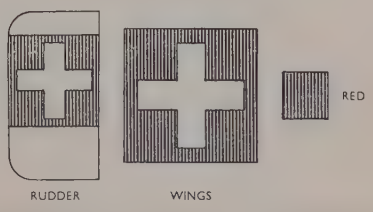
THE SUDAN AIR FORCE

SWEDEN



THE ROYAL SWEDISH AIR FORCE

SWITZERLAND



THE SWISS AIR FORCE

SYRIA
(UNITED ARAB REPUBLIC



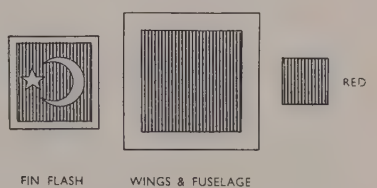
THE SYRIAN AIR FORCE

THAILAND



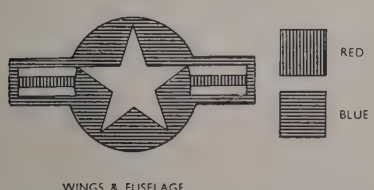
THE ROYAL THAI AIR FORCE

TURKEY



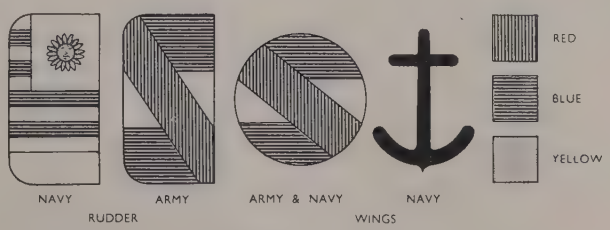
THE TURKISH AIR FORCE

UNITED STATES OF AMERICA



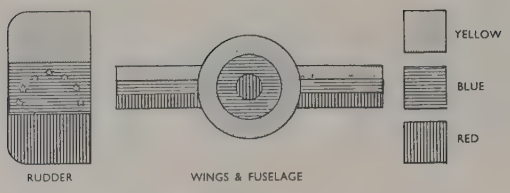
THE UNITED STATES AIR FORCE
AND ARMY AND NAVAL AVIATION

URUGUAY



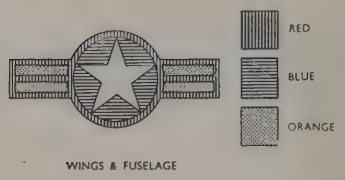
URUGUAYAN MILITARY AND NAVAL AVIATION

VENEZUELA



THE VENEZUELAN AIR FORCES

VIET-NAM



THE VIET-NAMESE AIR FORCE

YUGOSLAVIA



THE YUGOSLAV AIR FORCE

THE WORLD'S CIVIL AVIATION

ARRANGED IN

ALPHABETICAL ORDER OF NATIONS

INCLUDING DETAILS OF THE INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO), THE INTERNATIONAL AIR TRANSPORT ORGANIZATION (IATA), THE FÉDÉRATION AÉRONAUTIQUE INTERNATIONALE (FAI), AND OF THE AIRLINES OF THE WORLD

INTERNATIONAL CIVIL AIRCRAFT MARKINGS

AN- Nicaragua.
AP- Pakistan.
B- Taiwan (Nationalist China)
CB- and **CP-** Bolivia.
CC- Chile.
CCCP- Soviet Union (U.S.S.R.)
CF- Canada.
CR- Portuguese Overseas Possessions
CS- Portugal
CU- Cuba.
CX- Uruguay.
D- Western Germany.
DM- Eastern Germany.
EC- Spain.
EI- and **EJ-** Ireland.
EL- Liberia.
EP- Iran.
ET- Ethiopia.
F- France and the French Union.
G- United Kingdom.
HA- Hungary.
HB- Switzerland.
HC- Ecuador.
HH- Haiti.
HI- Dominican Republic.
HK- Colombia.
HL- Republic of Korea
HP- Republic of Panama.
HS- Thailand.
HZ- Saudi Arabia
I- Italy.
JA- Japan.
JY- Jordan.
JZ- Netherlands New Guinea.
LN- Norway.
LQ- and **LV-** Argentine Republic.
LX- Luxembourg.
LZ- Bulgaria.
MR- Principality of Monaco.
N United States of America.
OB- Peru.
OD- Lebanon.
OE- Austria.
OH- Finland.
OK- Czechoslovakia.
OO- Belgium.
OY- Denmark.
PH- Netherlands.
PI- Philippine Republic.
PJ- Netherlands Antilles.
PK- Indonesia.
PP- and **PT-** Brazil.
PZ- Netherlands Guiana.
SE- Sweden.
SN- Sudan.
SP- Poland.
SU- Egypt (United Arab Republic)
SX- Greece.
TC- Turkey.
TF- Iceland.
TG- Guatemala.
TI- Costa Rica.
VH- Australia.
VP-B Bahamas.
VP-F Falkland Islands.
VP-G British Guiana.
VP-H British Honduras.
VP-J Jamaica.
VP-K Kenya.
VP-L Leeward Islands.
VP-M Malta.
VP-N Nyasaland
VP-P Islands under the rule of the Western Pacific High Commission.
VP-R Northern Rhodesia
VP-S British Somaliland.
VP-T Trinidad and Tobago.
VP-U Uganda.
VP-V St. Vincent.
VP-X Gambia.
VP-Y Southern Rhodesia
VP-Z Zanzibar.
VQ-B Barbados.
VQ-C Cyprus.
VQ-F Fiji Islands.
VQ-G Grenada.
VQ-H St. Helena.
VQ-L St. Lucia.
VQ-M Mauritius.
VQ-S Seychelle Islands.
VQ-ZAA—ZDZ Basutoland
VQ-ZEA—ZHZ Bechuanaland
VQ-ZIA—ZIZ Swaziland
VR-A Aden.
VR-B Bermuda.
VR-G Gibraltar.
VR-H Hong Kong.
VR-L Sierra Leone.
VR-N Nigeria.
VR-O British North Borneo.
VR-R Malaya.
VR-S Singapore
VR-T Tanganyika.
VR-U Brunei.
VR-W Sarawak.
VT- India.
XA-, XB- and **XC-** Mexico.
XH- Honduras.
XT- Chinese People's Republic
XV- Viet-Nam.
XY- and **XZ-** Burma.
YA- Afghanistan.
YE- Yemen.
YI- Iraq.
YK- Syria (United Arab Republic)
YR- Rumania.
YS- El Salvador.
YU- Yugoslavia.
YV- Venezuela.
ZA- Albania.
ZK-, ZL- and **ZM-** New Zealand.
ZP- Paraguay.
ZS-, ZT- and **ZU-** Union of South Africa.
4R- Ceylon.
4X- Israel.
5A- Libya.
9G- Ghana.

INTERNATIONAL ORGANIZATIONS

THE INTERNATIONAL CIVIL AVIATION ORGANIZATION (I.C.A.O.)

HEADQUARTERS: International Aviation Building, Montreal, Canada.

THE COUNCIL

President: Ing. Walter Binaghi.

Member of the Council for the United Kingdom: J. H. Riddoch.

Secretary General: E. C. R. Ljungberg.

Assistant Secretary General for Air Navigation: T. S. Banes.

Assistant Secretary General for Air Transport: E. M. Weld.

Director, Bureau of Administration and Services: J. F. Berrier.

Director, Legal Bureau: P. K. Roy.

Director, Technical Assistance Bureau: E. R. Marlin.

Chief, Public Information: L. C. Boussard.

Member States (as at July 1, 1958): Afghanistan, *Argentina, *Australia, Austria, *Belgium, Bolivia, *Brazil, Burma, Cambodia, *Canada, Ceylon, Chile, China, Colombia, Cuba, Czechoslovakia, Denmark, Dominican Republic, Federal Republic of Germany, Ecuador, El Salvador, Ethiopia, Finland, *France, Germany, Ghana, Greece, Guatemala, Haiti, Honduras, Iceland, *India, Indonesia, Iran, Iraq, *Ireland, Israel, *Italy, *Japan, Jordan, Korea, Laos, *Lebanon, Liberia, Libya, Luxembourg, Malaya, *Mexico, Morocco, *Netherlands, New Zealand, Nicaragua, Norway, Pakistan, Paraguay, Peru, Philippines, Poland, *Portugal, Spain, Sudan, *Sweden, Switzerland, Thailand, Turkey, *Union of South Africa, *United Arab Republic, *United Kingdom, *United States, Uruguay, *Venezuela, Viet-Nam.

(*denotes Member of Council).

The International Civil Aviation Organization, successor to the Provisional International Civil Aviation Organization (P.I.C.A.O.), came into being on April 4, 1947, following the ratification of the Permanent Convention by the required number of States.

The Organization is governed by an Assembly and a Council.

The Assembly

Is convened by the Council. Extraordinary meetings of the Assembly may be held at any time when called by the Council or at the request of any ten member States. All member States have equal right to be represented at the meetings of the Assembly and each member is entitled to one vote. The powers and duties of the Assembly are: (*a*) to elect at each meeting its president and officers; (*b*) to elect the member States to be represented on the Council; (*c*) to examine and take action upon the reports of the Council; (*d*) to determine its own rules of procedure and establish such subsidiary commissions and committees as are needed; approve an annual budget and determine the financial arrangements of the Organization; (*e*) to refer any specific matters to the Council; (*f*) to delegate the necessary powers and authority to the Council which are needed for the duties of the organization; and (*g*) to deal with any matters not specifically assigned to the Council.

The Council

The Council is composed of 21 member States elected by the Assembly for a period of three years, adequate representation being given to: (1) those member States of chief importance in air transport; (2) those member States not otherwise included which make the largest contribution to the provision of facilities for international civil air navigation; (3) those member States not otherwise included whose election will ensure that all major geographical areas of the World are represented. No representative of a member State on the Council may be actively associated with or financially interested in the operation of an international air service.

The Council elects a President, who has no vote. One or more vice-presidents are elected from among the members, and retain the right to vote when serving as acting president. Decisions of the Council are deemed valid when approved by a majority of all members. Any member State not a member of the Council may participate in deliberations whenever any decision is to be taken which especially concerns such a member State, but such a State may not vote. In any case in which there is a dispute between one or more member States not members of the Council and one or more member States who are members of the Council, any State within the second category which is party to the dispute shall have no right to vote on that dispute.

The duties and powers of the Council are:—

(1) to discharge the directives of the Assembly.

(2) to determine its own organization.

(3) to determine the method of appointment, emoluments and conditions of service of the employees of the organization.

(4) to appoint a Secretary-General.

(5) to provide for the establishment of any subsidiary working groups which may be considered desirable, including the following:—

(*a*) A Committee on Air Transport.

(*b*) A Commission on Air Navigation.

(6) to prepare and submit to the Assembly budget estimates of the Organization and statements of accounts of all reports and expenditures.

(7) to enter into agreements with other international bodies when deemed advisable for the maintenance of common service and for common arrangements concerning personnel and, with the approval of the Assembly, enter into such other arrangements as may facilitate the work of the Organization.

In addition, the functions of the Council are to maintain liaison with the member States, calling on them for such data and information as may be required; receive, register and hold open to inspection by member States, all existing contracts and agreements covering routes, services, landing rights, airport facilities, or other international air matters to which any member State or its airlines is a party; supervise and co-ordinate the works of the subsidiary bodies, consider their reports and transmit them and the findings of the Council to the member States. In addition, the Council is to make recommendations on technical matters to the member States of the Assembly, and submit an annual report to the Assembly. When requested by all the parties concerned, the Council will act as an arbitral body on any difference arising among member States relating to international civil aviation matters which may be submitted to it.

The expenses of the Organization are borne by the member States in proportions decided by the Assembly. Each member State bears the expenses of its own delegation to the Assembly and those of its delegates on the Council and its representatives on committees or subsidiary groups.

Each contracting State undertakes that its international airlines shall file traffic reports, cost statistics and financial states with the Council. Each contracting State may designate the route to be followed within its territory by any international air service, and the airports which any such service may use. If the Council is of the opinion that the airports or other navigation facilities of a contracting State are not reasonably adequate the Council may consult with the State and others affected, to find means of correcting the position and may make recommendations. If requested by the State, the Council may provide all or a portion of the costs needed for the remedies.

A contracting State may at any time discharge any obligation into which it has entered and take over airports and other facilities which the Council has established in its territory by paying to the Council an amount considered reasonable.

The Council may suggest to contracting States that they form joint organizations to operate air services on any routes or in any regions.

The duties of the subsidiary bodies established under the Council shall be:—

Air Transport. To observe, correlate and report continually on facts concerning the origin and volume of international air traffic and the relation of such traffic, or the demand for it, to the facilities provided; collect, analyse and report on subsidies, tariffs and costs of operation; study matters affecting the organization and operation of international air services, including the international ownership and operation of international trunk lines; and study and report, with recommendations, to the Assembly on matters on which agreement was not reached at the Chicago International Civil Aviation Conference.

Air Navigation. To study and advise the Council on standards and procedures for communications systems and air navigation aids including rules of the air, traffic control practices, licensing of operating and mechanical personnel, airworthiness, registration and identification of aircraft, meteorological protection of international aeronautics, log books, maps and charts, airports, customs, accident investigation and so forth. In addition it will work towards the adoption of minimum requirements and standard procedures for all the above and continue the preparation of technical documents in accordance with the recommendations of the Chicago Conference.

THE INTERNATIONAL AIR TRANSPORT ASSOCIATION (I.A.T.A.)

HEAD OFFICE: Terminal Centre Buildings, 1060, University Street, Montreal 3, P.Q., Canada.

BRANCH OFFICES: 30, Curzon Street, W.1, London (I.A.T.A. Clearing House, I.A.T.A. European-African Technical Liaison Office); 500, Fifth Avenue, New York 36 (I.A.T.A. Traffic Conference No. 1, I.A.T.A. Enforcement Office); 76-78, Champs Elysées, Paris (8e.) (I.A.T.A. Traffic Conference No. 2); MacDonald House, Singapore, Malaya. (I.A.T.A. Traffic Conference No. 3).

President (1957-58): Dr. Tomas Delgado (IBERIA Airlines of Spain).

President-elect (1958-59): J. R. D. Tata (Air India International).

Director General: Sir William P. Hildred.

Treasurer and Financial Director: Dr. H. J. Gorecki.

Traffic Director: John Brancker.

Secretary: A. Laurence Young.

Legal Adviser: Prof. John C. Cooper.

Technical Director : Stanislaw Krzyczkowski.

Executive Committee : Sheikh Najib Alamuddin, Beirut ; I. A. Aler, The Hague ; Dr. Walter Berchtold, Zurich ; Ruben M. Berta, Porto Alegre ; René Briend, Paris ; Lord Douglas of Kirtleside, London ; Sir W. Hudson Fysh, Sydney ; Croil Hunter, St. Paul ; John C. Leslie, New York ; Major J. Ronald McGrindle, London ; Gordon R. McGregor, Montreal ; Per A. Norlin, Stockholm ; Gregorio Obregón, Bogota ; Gilbert Périer, Brussels ; Warren Lee Pierson, New York ; D. M. Robbertze, Johannesburg ; J. R. D. Tata, Bombay ; and S. Yanagita, Tokyo.

Financial Committee : A. V. Leslie (TWA), Chairman ; Dr. H. J. Gorecki, Secretary.

Legal Committee : W. A. Steenstra Toussaint (KLM), Chairman ; J. G. Gazdik, Secretary.

Medical Committee : A. M. Black, Secretary.

Technical Committee : A. V. J. Vernieuwe (SABENA), Chairman : Stanislaw Krzyczkowski, Secretary.

Traffic Advisory Committee : G. M. Bain (Northwest Airlines), Chairman.

Chief Enforcement Officer : R. Feick.

Economics and Statistics Officer : R. Heitmeyer.

Legal Drafting Officer : W. M. Sheehan.

Public Relations Officer : S. Ralph Cohen.

Facilitation Officer : C. W. R. Vallance.

Manager of London Clearing House : A. J. Quin-Harkin.

European Technical Liaison Officer : J. L. Gilmore.

Traffic Conference Secretaries : V. de Boursac (Paris) ; E. S. Pefanis (New York) ; R. A. McGowan (Singapore).

The International Air Transport Association was formally inaugurated on April 19, 1945, at Havana, following a conference of international airline operators. Invitations to the conference and plans for the new organization were drawn up at a conference held in Chicago in December, 1944, on the initiative of the American Air Transport Association and attended by 34 representatives of 21 nations. The new Association succeeds the original International Air Traffic Association founded in 1919.

Headquarters of I.A.T.A. are at Montreal, Canada, and the association consists of a General Assembly and an Executive Committee, in which is vested the management of the association. The post of President is honorary.

The aims and objects of I.A.T.A. are to promote safe, regular and economical air transport ; to foster the development of air commerce, and to study all problems connected therewith ; to provide efficient machinery for collaboration among all air transport operators who are engaged directly or indirectly in international air transport service ; and to co-operate with the International Civil Aviation Organization (I.C.A.O.) and other international bodies.

There are two categories of membership—Active and Associate. Any air transport enterprise is eligible for active membership if it operates a scheduled air service under proper authority for the carriage of passengers, mail or cargo, between the territories of two or more States, under the flag of a State eligible to membership in the International Civil Aviation Organisation.

The Active Members at July 1, 1958 were :—*Aer Lingus Teoranta (Dublin); *Aerlinte Eireann (Dublin) ; Aerolineas Argentinas (Buenos Aires) ; Aero O/Y (Finnair) (Helsinki); Aeronaves de Mexico (Mexico City) ; *Aerovias Nacionales de Colombia (AVIANCA) (Bogota) ; *Air Algérie (Algiers) ; *Air Ceylon (Colombo) ; *Air France (Paris) ; *Air India International (Bombay) ; Air Liban (Beirut) ; *Air Vietnam (Saigon) ; *Airwork (London) ; *Alitalia-LAI (Rome) ; *American Airlines Inc. (New York) ; *Austrian Airlines (Vienna) ; Aviacion y Comercio, S.A. (Madrid) ; †Braniff Airways Inc. (Dallas) ; *British European Airways (London) ; *British Overseas Airways Corporation (London) ; *Canadian Pacific Air Lines Ltd. (Vancouver) ; *Central African Airways Corporation (Salisbury Southern Rhodesia) ; *Ceskoslovenske Aerolinie, N.P. (Prague) ; Civil Air Transport (Taipei) ; †Compania Cubana de Aviacion (Havana) ; *Compagnie de Transports Aériens Intercontinentaux (TAI) (Paris) ; *Cyprus Airways Ltd. (Nicosia) ; †Delta Air Lines Inc. (Atlanta); *Deutsche Lufthansa (Cologne) ; Divisão de Exploração dos Transportes Aereos (DETA) (Lourenço Marques) ; Divisão de Exploração dos Transportes Aereos (DTA) (Luanda) ; Eagle Airways (London) ; East African Airways Corporation (Nairobi) ; †Eastern Airlines (New York) ; El Al, Israel Airlines Ltd. (Tel Aviv) ; *Empresa de Viação Aerea Rio Grandense (VARIG) (Porto Alegre) ; *Flugfelag Islands (Icelandair) (Reykjavik) ; *Garuda Indonesian Airways N.V. (Djakarta) ; *Guest Aerovias Mexico, S.A. (Mexico City) ; *Hunting-Clan Air Transport Ltd. (London) ; Indian Airlines Corporation (New Dehli) ; IBERIA (Airlines of Spain) (Madrid) ; Iranian Airways (Teheran) ; *Iraqi Airways (Baghdad) ; *Japan Air Lines Company, Ltd. (Tokyo) ; *Jugoslovenski Aerotransport (JAT) (Belgrade); *KLM Royal Dutch Airlines (The Hague); Linea Aerea Nacional (LAN) (Santiago, Chile) ; *Linea Aeropostal Venezolana (Caracas) ; *Malayan Airways Ltd. (Singapore) ; *Middle East Airlines (Beirut) ; Misrair, S.A.E. (Cairo) ; †National Airlines Inc. (Miami) ; *Northwest Airlines Inc. (St. Paul) ; *Olympic Airways (Athens) ; *Pakistan International Airlines (Karachi) ; *Panair do Brasil, S.A. (Rio de Janeiro) ; *Pan-American Grace Airways Inc. (New York) ; *Pan-American World Airways Inc. (New York) ; *Philippine Air Lines Inc. (Manila) ; Polish State Airlines (LOT) (Warsaw) ; *Qantas Empire Airways, Ltd. (Sydney) ; *Scandinavian Airlines System (Stockholm) ; *Seaboard and Western Airlines, Inc. (New York) ; Services Aereos Cruzeiro do Sul, Ltda. (Rio de Janeiro) ; Skyways, Ltd. (London) ; *Sabena (Brussels) ; *South African Airways (Johannesburg) ; Swissair (Zurich) ; *Tasman Empire Airways Ltd. (Auckland) ; *Trans Canada Air Lines (Montreal) ; Transportes Aereos Portugueses (TAP) (Lisbon) ; *Trans World Airlines, Inc. (New York) ; Turk Hava Yolari (Turkish Airlines) (Ankara) ; *Union Aéromaritime de Transport (UAT) (Paris); United Air Lines (Chicago).

(* Member of I.A.T.A. Clearing House).

(† Clears via Airlines Clearing House).

Associate membership may be obtained by any air transport concern operating an authorised scheduled air service under the flag of a State eligible for membership in the International Civil Aviation Organization. The Associate Member companies are :—Ansett-ANA (Melbourne) ; Chicago Helicopter Airways, Inc. (Chicago) ; The Flying Tiger Line (Burbank) ; †New York Airways Inc. (New York) ; *New Zealand National Airways (Wellington) ; *Quebecair (Rimouski) ; *Trans-Australia Airlines (Melbourne) ; Trans-Caribbean Airways (New York).

The creative work of I.A.T.A. is done largely by five Standing Committees—Financial, Legal, Medical, Technical and Traffic Advisory. Their affairs are administered by I.A.T.A.'s small secretariat who provide services for them and carry forward their recommendations. Rules for the conduct of the committees are laid down, and their decisions subject to final approval by the Executive Committee.

The Financial Committee has in its purview all financial matters connected with air transport ; standardization of methods of rendering ; verifying and settling accounts for revenue transactions between members ; aeronautical insurance matters ; introduction and control of money documents ; and statistical matters. An important step was the creation of the I.A.T.A. Clearing House, whose operations provide for the airlines an approach to an international currency. Set up to handle the inter-company revenue transactions of I.A.T.A. members, the Clearing House offsets their balances on a monthly basis and consolidates the result into a single monthly statement to each. Besides eliminating exchange risks and the costs involved in the ordinary settlement of these accounts the Clearing House makes it possible for its members to do business in both sterling and dollars.

An agreement was reached in May, 1948, for inter-clearance between I.A.T.A. and the Airlines Clearing House, Chicago. This arrangement between the two clearing houses enables the North American operators to accept bookings from soft currency areas, as well as from those countries which can pay in dollars, and to exchange business under the terms of the Universal Air Travel Plan.

The Legal Committee deals generally with legal matters having a bearing on international air transport, particularly with international conventions on public and private air law and on other means of transport ; with conflicts of law and with arbitration.

The Medical Committee has within its purview the physiological and psychological aspects of flight as they affect passengers and aircrew ; international sanitary regulations, etc.

The Technical Committee concerns itself with all international operational and engineering matters ; promotion of safety and efficiency in flight ; standardization of equipment and consumable spares ; unification of procedures ; radio and electronics ; meteorology ; maintenance of aircraft ; airways and ground aids. Once a year, the personnel of the Technical Committee and its various working groups hold a Technical Conference, in which the airlines of the world exchange technical information and recommend technical policy on an international basis. Government agencies, manufacturers, research establishments and other international organizations also participate in these Conferences.

I.A.T.A.'s technical branch has achieved a large measure of unification of operating practices as between the airlines themselves. An exchange of vital information about the causes of accidents and near accidents, as well as about other practical matters, is fruitfully carried on. I.A.T.A. technical delegations have also played a part in working out the allocation of frequencies for communications purposes voted by the International Telecommunications Union Conference, and have co-operated also with the International Meteorological Organization and others.

Under the heading of Traffic, I.A.T.A. is concerned with all matters involving passengers, cargo and the handling of mail. It continually studies tariffs and schedules ; general conditions of carriage ; all matters pertaining to agents ; and the forms, documents and procedures used by the airlines themselves or required of them and their customers by governments. Traffic work is co-ordinated by the Traffic Director and the Traffic

Advisory Committee and the Association's studies represent the best opinion of the whole industry, arrived at from the point of view of the worldwide air transport network.

Applying many of these recommendations to day-to-day operations over the whole world and under highly variable conditions, is a complicated and delicate task. The final recommendations on rates and tariffs, conditions of carriage and agency matters are therefore left to Conferences, made up of the companies concerned actually providing service in any of the three following regions: I—North and South America, Greenland and the Hawaiian Islands; II—Europe, Africa and the Middle East, including Iran; and III—Asia, Australasia and the islands of the Pacific.

Within their terms of reference, the Traffic Conferences are autonomous. Their resolutions must be passed unanimously, and because of the high degree of public interest involved, they are subject to the approval of a number of governments.

This public concern applies particularly to the matters of rates and fares; many governments have, by international agreement or national law, recognized the Conferences as agencies by which their various economic interests in international air transport can be fairly adjusted.

In traffic procedures and practices, the I.A.T.A. Traffic Conferences have achieved a degree of worldwide uniformity unprecedented in the history of transport. Since the first worldwide joint Traffic Conference meetings at Rio de Janeiro, in October, 1947, I.A.T.A. has achieved the adoption of worldwide uniform tickets, air waybills, consignment notes and other documents; flight-line numbers and airline designators; conditions of contract and agency agreements and resolutions; as well as the development of a worldwide rate structure. Most recent achievements include the extension of the interline agreements and the services of more than 100 carriers throughout the World; the adoption of the first uniform Worldwide conditions of carriage in the history of transportation; and of a uniform restricted articles code applicable on a Worldwide basis to cargo. The three Conferences now meet in Composite session.

A basic part of the work of I.A.T.A. is daily co-operation with I.C.A.O. in the drafting of the latter organization's Standards and Recommended Practices, which set an international pattern for national technical regulation of aviation. Experts of I.A.T.A. member airlines and members of the I.A.T.A. Secretariat participate in all regional and divisional meetings of I.C.A.O., making available to the government organization the practical operating knowledge of the airlines. This technical work has been both intensive and extensive, covering all phases of technical operations and concerning itself with a multitude of details.

I.A.T.A. maintains close contact with I.C.A.O. in many other fields. Both organizations are vitally concerned in the campaign to facilitate international commerce by air, and I.A.T.A. has formed regional committees of airline operators to encourage government adoption of the I.C.A.O. Facilitation Standards.

Other organizations with whom I.A.T.A. maintains close working liaison include the Universal Postal Union, International Telecommunications Union, and other organizations in the fields in which air transport is interested.

I.A.T.A. has been commissioned by its members to issue certain publications on their behalf. Among these, the following are available to the interested public and may be ordered from the Head Office at Montreal:—

I.A.T.A. Bulletin. Published yearly in English, French and Spanish editions as the official record of the proceedings of the Association. $2.00 (U.S.) per copy.

Tabulation of Great Circle Distances. $5.00 (U.S.) per year, including 12 months' revision service.

Universal Interline Reservations Code. Given publication through various air guides.

FÉDÉRATION AÉRONAUTIQUE INTERNATIONALE (F.A.I.)

HEAD OFFICE: 6, RUE GALILÉE, PARIS, FRANCE.

President: Miss Jacqueline Cochran (U.S.A.).

First Vice-President: M. Jacques Allez (France).

Director General: Mr. H. R. Gillman, O.B.E. (Great Britain).

Treasurer General: M. Jean Blériot (France).

Vice-Presidents: Dr. Josef Gaisbacher (Austria); Capt. J. Foltmann (Denmark); *Jacques Allez (France); Carl Francke (Germany); *Capt. K. J. G. Bartlett (Great Britain); *C. Kolff (Netherlands); General Nils Söderberg (Sweden); *S. Staritchevsky (U.S.S.R.); *Slobadan Sakota (Yugoslavia); Dr. Charles Sillevaerts (Belgium); Mr. C. Robles Ochoa (Mexico); *Dr. W. Muri (Switzerland); *Mr. J. J. Ide (U.S.A.); *D. Federico Norena Echevarria (Spain).

*Members of the Board of the F.A.I.

The *Fédération Aéronautique Internationale* was founded in Paris, in October, 1905. The countries represented at its foundation were Belgium, France, Germany, Great Britain, Italy, Spain, Switzerland, and the United States of America. The aim was co-operation between nations concerning aeronautics and with the development of aviation the F.A.I. has become the international representative body of world private aviation. The first record to be officially homologated by the F.A.I. was a speed record of 41.29 km.h. (25.06 m.p.h.) set up on November 12, 1906 by Alberto Santos Dumont. He was timed over a distance of 220 metres (721 feet), which was as far as he could then fly.

Before and between the two wars many international arrangements were made under the supervision of the F.A.I. and international rules and sports codes for private flying were drawn up. Most of the countries which were represented on the F.A.I. through their accredited national Aero Clubs have agreed to recognise the *Carnet de passages en Douane* making private flying between countries easier. Landing facilities and international sport and touring licences were introduced. The F.A.I. also played an important *rôle* in the development of gliding, soaring and model aircraft flying.

All World or National Records must be observed by a representative of a national Aero Club affiliated to the F.A.I. before such a record is homologated or approved by the F.A.I.

The F.A.I., through its *Commission Internationale de l'Aviation Legère et du Tourisme Aérien* (C.I.A.L.T.A.) maintains the closest co-operation with I.C.A.O. through a liaison officer in Montreal.

The F.A.I. sits annually in general conference, but its various commissions sit more often.

The following is the list of national Aero Clubs, Federations or Associations which are affiliated to the F.A.I.

Argentina. Aero-Club Argentino, Rodriguez Pena 240, Buenos Aires.

Australia. The Aero Club Federation of Australia, 108 Queen Street, Melbourne.

Austria. Oesterreichischer Aero-Club, Salesianergasse 1, Vienna III.

Belgium. Aero-Club Royal de Belgique, 53 Avenue des Arts, Brussels.

Brazil. Aero-Club do Brasil, Av. Brasil s/n Manguinhos, Rio de Janeiro.

Bulgaria. Aéro-Club Central de la Republique Populaire de Bulgarie, Rue Cristo Botev, 48, Sofia.

Canada. The Royal Canadian Flying Clubs Association, 77, Metcalfe Street, Ottawa.

Chile. Federacion Aerea de Chile, Huérfanos 1147, Officina 642, Santiago du Chile.

Colombia. Aero-Club de Colombia, Edificio Narino, Avenida Jimenez de Quesada 11-28, Bogota.

Cuba. Club de Aviacion de Cuba, Edificio Larrea 206, Aguiar y empedrado, Havana.

Czechoslovakia. Aeroklub Republiky Ceskoslovenské, Opeletalova 29, Prague.

Denmark. Kongelig Dansk Aeroklub, Osterbrogade 40, Copenhagen.

Ecuador. Aero-Club del Ecuador, Casilla 348, Guayaquil.

Egypt. Aéro-Club d'Egypte, 26 rue Cherif Pacha, Cairo.

Finland. Suomen Ilmailuliitto, Mannerheimintie 16, Helsinki.

France. Aéro-Club de France, 6 rue Galilée, Paris.

German Federal Republic. Deutscher Aero-Club e V., Bockenheimer Landstr, 19/II, Frankfurt-am-Main.

Great Britain. The Royal Aero Club of the United Kingdom, 119 Piccadilly, London, W.1.

Greece. Royal Aero Club of Greece, 35 Jan Smuts Street, Athens.

Hungary. Magyar Nepkoztarsasag "Fehervari Miklos" Kozponti Repulo Klubja. Engelster 14, Budapest V.

Iceland. Flugmalafelag Islands, Reykjavik Airport, Reykjavik.

India. Aero Club of India, United India Life Building, Connaught Place, New Delhi 1.

Ireland. Irish Aviation Club, Dublin Airport, Dublin.

Israel. The Aero Club of Israel, 9 Montefiore Street, P.O.B. 1311, Tel Aviv.

Italy. Aero-Club d'Italia, via Cesare Beccaria 35, Rome.

Japan. Nippon Koku Kyokai, Hikokan (Aviation) Building, 1-3 Tamura-Cho, Minato-Ku, Tokyo.

Luxemburg. Aéro-Club du Grand-Duché de Luxembourg, Boite Portale 212, Luxembourg-Ville.

Mexico. Club Aereo de Mexico, Aeropuerto Central, Mexico D.F.

Morocco. Fédération Royale de Sports Aéronautiques, 8 rue Seine, Casablanca.

Monaco. Aero-Club de Monaco, 8 rue Grimaldi, Monaco.

Netherlands. Koninklijke Nederlandse Vereniging Voor Luchtvaart, Josef Israelsplein 8, The Hague.

New Zealand. Royal New Zealand Aero Club, 39 Johnston Street, Wellington C.

Norway. Norsk Aero-Klubb, ovre Vollgate 7, Oslo.

Peru. Aero-Club del Peru, Baquijano 722, Lima.

Poland. Aeroklub Rzeczypospolitej Polskiej, Krakowskie Przedm 55, Warsaw.

Portugal. Aéro-Club de Portugal, Avenida da Liberdade 226, Lisbon.

South Africa. The Aero Club of South Africa, P.O. Box 2312, Johannesburg.

Soviet Union. Aero-Club Central de l'U.S.S.R., V.P. Tchkalov, Moscow—Touchino.

Spain. Real Aero-Club de Espana, Carrera de San Jeronimo 19, Madrid.

Sweden. Kungl. Svenska Aeroklubben, Malmskillnadsgaten 27, Stockholm.

Switzerland. Aero-Club de Suisse, Hirschengraben 22, Zurich.

Turkey. Turk Hava Kurumu, Enstitü Caddesi 1, Ankara.

United States. National Aeronautic Association of U.S.A., 1025 Connecticut Avenue, Washington D.C.

Uruguay. Aero-Club del Uruguay, Paysandu 896, Montevideo.

Venezuela. Federacion Venezolana de Aeronautica, Apartado 336, Edificio Ayacucho, Conde a Padre Sierra, Çaracas.

Yugoslavia. Vazduhoplovni Savez Jugoslavije, Uzun Mirkova 4/1, Belgrade.

WORLD'S RECORDS

Homologated by the Fédération Aéronautique Internationale (as at August 1st, 1958)

ABSOLUTE RECORDS IRRESPECTIVE OF CLASS

Distance in Straight Line (U.S.A.).
Cdr. T. D. Davies, Cdr. E. P. Rankin, Cdr. S. Reid, Lieut-Cdr. R. A. Tabeling, U.S.N. in a Lockheed P2V-1. Perth, Australia, to Columbus, Ohio, U.S.A. September 29-October 1, 1946. 18,081.99 km. (11,235.6 miles).

Distance in Closed Circuit (U.S.A.).
Lieut. Col. Lassiter and Capt. W. J. Valentine, U.S.A.F. in a Boeing B-29. August 1-3, 1947. 14,249.656 km. (8,854 miles).

Height (U.S.A.).
Capt. D. G. Simons, U.S.A.F., in a balloon. August 19-20, 1957. 30,942 m. (101,489.7 ft.).

Speed (U.S.A.).
Capt. W. Irwin, U.S.A.F., in a Lockheed F104A (General Electric J79 engine) May 16, 1958. 2,259.5 km.h. (1,403.15 m.p.h.).

Speed in Closed Circuit (U.S.A.).
R. O. Rahn in a Douglas XF4D-1 (Westinghouse J40 engine). Edwards AFB, California. October 16, 1953. 1,171.788 km.h. (727.67 m.p.h.).

RECORDS BY CLASS

The following Classes are recognised by the F.A.I. for record purposes :—Class A (Spherical Balloons) ; Class B (Dirigibles); Class C (Powered Aircraft) ; Class D (Motorless Aircraft) ; and Class E (Rotary-wing Aircraft). Listed below are the principal records for Speed, Altitude and Distance in Classes C, D and E. Classes A and B, for which no records have been claimed recently, are not included.

CLASS C (POWERED AIRCRAFT).

Group 1 (*Aircraft powered by gas turbines*).

Speed (U.S.A.).
Capt. W. Irwin, U.S.A.F. in a Lockheed F-104A (General Electric J79 engine) May 16, 1958. 2,246.7 km.h. (1,409.19 m.p.h.).

Height (U.S.A.).
Major H. C. Johnson, U.S.A.F. in a Lockheed F-104A (General Electric J79 engine). May 7, 1958. 27,811 m. (91,244 ft.).

Distance in a Straight Line (U.S.A.).
Brig. Gen. W. E. Eubank, Lt. Col. K. R. Rea, Major C. Wells, plus 5 crew, in a Boeing KC-135 (four Pratt & Whitney J57 engines). April 7-8, 1958. Tokyo-Lajes, Azores. 16,462.5 km. (10,230 miles).

Distance in Closed Circuit (U.S.S.R.).
Youry Alacheev and V. Kokalev in a Tupolev TU-104A (two RD turbojets). Sternberg-Youshnaya Basissnaya. September 11, 1957. 2,002.6 km. (1,243.6 miles).

Group 2 (*Aircraft powered by piston engines*).

Speed (Germany).
Fritz Wendel in a Messerschmitt Bf 109R (Daimler-Benz engine). Augsberg. April 26, 1939. 755.138 km.h. (469.2 m.p.h.).

Altitude (Italy).
Mario Pezzi in a Caproni Ca. 161*bis* (Piaggio XIR.C engine). Montecelio. October 22, 1938. 17,083 m. (56,046 ft.).

Distance in Straight Line (U.S.A.).
As Absolute Record.

Distance in Closed Circuit (U.S.A.).
As Absolute Record.

CLASS C*bis* (SEAPLANES.)

Speed (Italy).
Francesco Agello in a Macchi M.C. 72 seaplane. October 23, 1934. 709.209 km.h. (440.68 m.p.h.).

Height (Italy).
Lieut. Col. N. di Mauro in a Caproni 161*bis* seaplane. September 25, 1939. 13,542 m. (44,429 ft.).

Distance in Straight Line (Great Britain).
Capt. D. C. T. Bennett and 1st Officer I. Hervey in Short-Mayo "Mercury" seaplane (composite launch). Dundee, Scotland, to Port Nolloth, South Africa. October 6-8, 1938. 9,652 km. (5,997.5 miles).

CLASS D (MOTORLESS AIRCRAFT).

1—*Single-seat sailplanes.*

Duration (France).
Charles Atger in an Arsenal Air-100. Romanin les Alpilles. April 2-4, 1952. 56 hours, 15 minutes.

Distance in Straight Line (U.S.A.).
Richard H. Johnson in a Ross-Johnson. From Odessa, Texas, to Salina, Kansas. August 5, 1951. 861.272 km. (535.19 miles).

Absolute Height (U.S.A.).
W. S. Ivans, Jr. in a Schweizer SGS 1-23. Bishop, California. December 30, 1950. 12,832 m. (42,099.6 ft.).

2—*Multi-seat sailplanes.*

Duration (France).
Dauvin and Couston in a Kranick III. Romanin les Alpilles, April 6-8, 1954. 57 hours, 10 minutes.

Distance in a Straight Line (U.S.S.R.).
Victor Iltchenko and G. Petchnikov in an A.10 sailplane from Kountsevo to Hovlia, May 26, 1953. 829.822 km. (515.626 miles).

Absolute Height (U.S.A.).
Lawrence E. Edgar and Harold E. Klieforth in Pratt-Read G.1. Bishop, Cal. March 19, 1952. 13,489 m. (44,255 ft.).

CLASS E (ROTARY-WING AIRCRAFT).

Distance in Straight Line (U.S.A.).
Elton J. Smith in a Bell 47D1. Fort Worth, Texas, to Niagara Falls, N.Y. September 17, 1952. 1,958.796 km. (1,217.1 miles).

Height (U.S.A.).
Capt. James Bowman, U.S.A.F., in a Cessna YH-41 (270 h.p. Continental FSO-526 engine). December 28, 1957. 9,076 m. (29,769.3 ft.).

Speed (U.S.A.).
Major R. L. Anderson and Robert S. Decker in a Sikorsky HR2S-1. November 11, 1956. 261.91 km.h. (162.64 m.p.h.).

Airline	Head Office and Management	Fleet	Route Mileage	Miles Flown 1957	Passengers 1957	Mail (lb.) 1957	Freight (lb.) 1957	Remarks
ADEN								
Aden Airways Ltd.	Khormaksar Gen. Manager: H. W. C. Alger Comm. Manager: L. V. Bennett	8 Douglas DC-3	22,840	1,403,517 *463,793*	40,341 *5,703*	176,193 *752*	4,903,135 *2,014,674*	A wholly-owned subsidiary of Associated British Airlines (Middle East) Ltd., Stratton House, Stratton Street, London, W.1.
AFGHANISTAN								
Ariana Afghan Airlines Company Ltd.	P.O. Box 76, Kabul, President: Faiz Mohd. Ahmedzai Ops. Manager: Ralph D. Rhea	2 Douglas DC-4 3 Douglas DC-3 *On order:* 1 Douglas DC-4	7,200	1,100,000 *350,000*	15,687 *3,367*	5,728 ton-miles	1,303,000 ton-miles	Statistics cover period March 21 to December 23, 1957. Pan American acquired 49% interest in 1957.
ALASKA								
Alaska Airlines, Inc.	2320 Sixth Avenue, Seattle 1, Washington, U.S.A. President: Charles F. Willis, Jr. Senior Vice-President: Richard W. Gilbert	1 Douglas DC-6C 3 Douglas DC-4 1 Douglas DC-3 3 Curtiss C-46 14 single-engine aircraft *On order:* 1 Douglas DC-6C	4,810	2,302,743 *671,940*	41,404 *25,625*	2,680,999	6,351,057 *9,595,409*	—
Alaska Coastal Airlines	2 Marine Way, Juneau Co-Managers: S. B. Simmons O. F. Benecke Ops. Manager: H. S. Gruening	9 Grumman Goose 2 Consolidated PBY Canso 1 Bellanca Pacemaker 1 Cessna 195 1 Cessna 180 2 Piper Pacer 1 Hiller 12C *On order:* 2 Cessna 180	—	537,002	43,460	48,116 ton-miles	45,200 ton-miles	A partnership of Alaska Air Transport, Inc. and Marine Airways Corporation.
Cordova Airlines, Inc.	Anchorage International Airport President: Merle K. Smith Vice-President (Ops.): David P. Swanson	1 Curtiss C.W.20 2 Douglas DC-3 2 Grumman Widgeon 2 Cessna 180 3 Cessna 170 2 Piper Super Cub	1,824	265,124 *822,899*	12,183 *7,215*	628,727	1,650,516 *8,622,026*	—
Ellis Air Lines	P.O. Box 1059, Ketchikan President: R. E. Ellis Vice-President (Ops.): G. A. Bodding	9 Grumman G-21-A 1 Cessna 180	665	639,753 *205,638*	55,473 *7,695*	24,049	30,052 *2,493*	—
Northern Consolidated Airlines, Incorporated	Box 6133, International Airport Anchorage President & Gen. Manager: Raymond I. Petersen Vice-President & Treasurer: S. B. Fitzhugh	4 Douglas DC-3 10 Cessna T-50 *On order:* 3 Fairchild F-27	—	1,269,473 *148,020*	18,727 *2,500*	1,906,000	5,712,000 total	—
Reeve Aleutian Airways, Inc.	Box 559, Anchorage President & Supt. Ops.: Robert C. Reeve	1 Douglas DC-4E 2 Douglas DC-3 2 Grumman Goose 1 Curtiss C.W.20	2,308	593,968 *69,918*	7,578 *1,329*	575,695	1,014,546 *358,492*	
Wien Alaska Airlines, Inc.	P.O. Box 649, Fairbanks President & Gen. Manager: Sigurd Wien Exec. Vice-President & Treasurer: Geo. B. Rayburn Vice-President (Ops.): Fritz Wien	3 Douglas DC-3 4 Curtiss C-46 3 Beechcraft 18S 7 Single-engine aircraft *On order:* 3 Fairchild F-27	4,473	1,581,562 *1,018,168*	22,132 *6,281*	398,752 ton-miles	468,407 ton-miles *2,004,081* ton-miles	—
ALGERIA								
Compagnie Générale de Transports Aériens Air Algérie	46 Boulevard, Saint-Saëns, Algiers President and Dir. General: M. J. Richard Deshais	2 Lockheed Constellation 8 Douglas DC-4 3 Douglas DC-3 3 Nord Noratlas *On order:* 3 Sud Caravelle	—	—	—	—	—	Formed in 1953 by merger of original Air Algérie and Cie. Air Transport.
ARGENTINA								
Aerolineas Argentinas, Empresa del Estado	Paseo Colon 185, Buenos Aires President: Luis C. Ureta Saenz Pena Vice-President and Technical Director: Venancio E. Fabri	14 Douglas DC-3 6 Douglas DC-6 6 Douglas C-54B 2 Douglas C-47 4 Convair 240 6 Short Sandringham *On order:* 6 D.H. Comet 4	41,873	13,137,119 *158,575*	463,021 *6,297*	1,032,695 *3,261*	6,049,213 *153,138*	State-owned.

Non-scheduled traffic figures in italic type.

Airline	Head Office and Management	Fleet	Route Mileage	Miles Flown 1957	Passengers 1957	Mail (lb.) 1957	Freight (lb.) 1957	Remarks
ARGENTINA—*cont.*								
Compania Aerotransportes del Litoral Argentino (ALA)	—	*On order:* 6 Aero Commander	—	—	—	—	—	Private company to operate between Mendoza and Montevideo.
Lineas Aereas Aeronorte	—	D.H. Beavers Cessna 310's Cessna 180's	—	—	—	—	—	Private company. Operates from Misionesa and serves Iguarzu, Posedas, Corrientes and Resistencia.
Lineas Aereas del Estado (LADE)	Corrientes 480, Buenos Aires	Douglas DC-3's Vickers Vikings	—	896,324	24,046	69,112	—	Formed by Argentine Air Force and started operations in September 1940. Operates domestic services.
Transatlantica S.A. de Aeronavegacion	Avenida Julio A. Roca 610, 6°, Buenos Aires Man. Director: Juan José Francisco Requal	3 Douglas DC-4 *On order:* 3 Douglas DC-6B	—	—	—	—	—	Founded in March, 1958. Authorised to operate service to Europe.
Transcontinental Sociedad Anónima de Transportes Commercial é Industrial Gaecia	Cerrito 1117, Buenos Aires President: Manuel R. Masllorens Gen. Manager: Adolfo Aliage	5 Curtiss C-46 *On order:* 3 Lockheed L-1049H Super Constellation 4 Convair 880	2,330	597,000	52,758	6,820	110,000	Private company which started domestic operations in March, 1957.
AUSTRALIA								
Ansett Airways Pty. Ltd. Australian National Airways Pty. Ltd.	289 William Street, Melbourne, C.1 Man. Director: R. M. Ansett Gen. Manager: J. A. West Lau Comm. Manager: F. Pascoe	4 Douglas DC-6B 2 Douglas DC-6 7 Douglas DC-4 8 Douglas DC-3 2 Short Sandringham 6 Convair 440 2 Convair 340 3 Bristol 170 1 Bristol Sycamore 1 S.O.1221 Djinn *On order:* 3 Lockheed Electra 6 Vickers Viscount 832 6 Fokker Friendship	18,946	15,684,124 *512,737*	826,898 *6,269*	2,105,720	93,085,847 *1,580,035*	Ansett Airways Pty. Ltd. and Australian National Airways Pty. Ltd. became Ansett-A.N.A. as from October 20, 1957. Acquired Butler Air Transport in 1958.
Butler Air Transport Ltd.	Kingsford Smith Airport, Mascot, Sydney, N.S.W. Man. Director: C. A. Butler Ops. Manager: C. Henry	2 Vickers Viscount 747 3 Airspeed Ambassador 3 Douglas DC-3	9,735	3,000,000	57,000	30,000	5,000,000	Queensland Airlines Pty., Ltd. is a subsidiary. Acquired by Ansett-A.N.A. in 1958.
Connellan Airways Limited	Townsite Aerodrome, Alice Springs, Northern Territory Gov. Director: E. J. Connellan Manager: I. M. Leslie	1 D.H. Rapide 2 Beechcraft C18S 1 Beechcraft D17S 2 Cessna 180 2 D.H. Tiger Moth *On order:* 1 Cessna 180	10,626	346,389 *138,441*	1,683 *765*	71,135 n.a.	133,732 n.a.	—
East-West Airlines Ltd.	Tanworth, N.S.W. Chairman: D. M. Shand Gen. Manager: Capt. A. J. Smith	4 Douglas DC-3 2 Lockheed Hudson *On order:* 1 Douglas DC-3	3,158	974,550	64,629	7,483	1,555,033	Hudsons used on aerial survey contracts.
Guinea Airways Ltd.	Airways House, 132 North Terrace, Adelaide, S.A. Chairman: S. Powell	5 Douglas DC-3 1 Auster Autocar	1,712	972,496	89,138	188,042	2,756,992	Statistics for year ended February 28, 1958.
MacRobertson Miller Airlines Ltd. (M.M.A.)	194 St. George's Terrace, Perth, Western Australia Man. Director: C. N. Kleinig Ops. Manager: K. D. Cohen	5 Douglas DC-3 3 D.H. Dove 3 Avro Anson	21,390	2,536,768 *218,097*	44,557 *1,264*	204,851 *1,985*	3,662,838 *2,565,623*	Subsidiary Companies - Commercial Aviation Pty. Ltd., and Airlines (W.A.) Ltd. Associate Company — Air Beef Pty. Ltd.
Qantas Empire Airways Ltd. (Q.E.A.)	Qantas House, 70 Hunter Street, Sydney, N.S.W. Chairman: Sir Wilmot Hudson Fysh, K.B.E., D.F.C. Chief Executive and Gen. Manager: C. O. Turner,	16 Lockheed Super Constellation 5 Douglas DC-4 8 Douglas DC-3 2 Convair Catalina 4 D.H. Beaver 1 D.H. Drover *On order:* 7 Boeing 707-138 4 Lockheed Electra	63,301	13,572,778 *1,161,062*	137,388 *23,243*	2,838,056 *90,300*	6,550,169 *11,566,914*	A public company in which Australian Government holds all shares. Took over trans-Pacific routes of B.C.P.A. on April 1, 1954. Acquired Fiji Airways, March, 1958.

Non-scheduled traffic figures in italic type.

Airline	Head Office and Management	Fleet	Route Mileage	Miles Flown 1957	Passengers 1957	Mail (lb.) 1957	Freight (lb.) 1957	Remarks
AUSTRALIA—*cont.*	C.B.E.							
Queensland Airlines Pty. Ltd.	Brisbane Airport, Brisbane, Queensland Man. Director: Capt. R. S. Adair, O.B.E.	3 Douglas DC-3 (Extra aircraft chartered as required)	8,711	875,800	50,700	32,000	2,160,800	—
Southern Airlines Limited	No. 8 Hangar, Essendon Airport, Victoria Man. Director: R. R. Barnewall Ops. Manager: L. R. Edwards	2 D.H. 104 Dove 1 Auster Autocar *On order:* 2 D.H. 114 Heron	—	421,397 *8,982*	7,431 *230*	1,525	258,194 *25,000*	This Company, operated on a co-operative basis, is owned by the cities and towns served.
Trans-Australia Airlines (T.A.A.)	339 Swanston Street, Melbourne, Victoria Chairman: W. D. McDonald, C.B.E. Gen. Manager: J. P. Ryland, D.F.C.	11 Vickers Viscount 720 and 756 2 Convair 240 4 Douglas DC-4 17 Douglas DC-3 4 D.H. Drover 3 Hiller 12C *On order:* 2 Vickers Viscount 756 12 Fokker Friendship 2 Lockheed Electra	29,180	16,339,491 *97,348*	811,977 *846*	2,669,887	35,668,000 *232,166*	State-owned Trans-Australia Airlines (T.A.A.) is the operating or trade name of the Australian National Airlines Commission instituted under the Australian National Airlines Act 1945-1952.
Woods Airways Pty. Ltd.	National House, 49 William Street, Perth, Western Australia Man. Director: Capt. J. Woods	2 Avro Anson	52	28,650	5,202	1,200	24,143	Operates the shortest scheduled airline route in the world, between Perth and Rottnest Island.
AUSTRIA								
Österreichische Luftverkehrs A.G. (Austrian Airlines)	1 Salesianergasse, Vienna 3 President: Dr. Josef Joham Managers: Dipl. Ing. T. Trimmel and Sepp Froeschl	4 Vickers Viscount 779D	3,250	—	—	—	—	Began operations in 1958. SAS and Fred Olsen Airtransport each have 15% interest. Aircraft are leased from Fred Olsen.
BAHRAIN								
Gulf Aviation Co. Ltd.	Manama, Bahrain (Persian Gulf) Chairman: G. B. Thompson, F.Inst. Pet. Exec. Director: E. H. W. Lewis	4 D.H. Dove 2 D.H. Heron *On order:* 1 D.H. Heron	1,173	305,500 *324,875*	40,358 n.a.	179,652 n.a.	315,369 n.a.	A subsidiary of B.O.A.C.
BELGIUM								
Société Anonyme Belge d'Exploitation de la Navigation Aérienne (SABENA)	Air Terminus, Brussels Chairman of the Board: Gilbert Périer Man. Director: Gaston Claeys Gen. Manager: Willem Deswarte	6 Douglas DC-7C 2 Douglas DC-6C 8 Douglas DC-6B 3 Douglas DC-6 9 Douglas DC-4 18 Douglas DC-3 10 Douglas C-47 12 Convair 440 8 Sikorsky S-58 1 Bell 47 H1 1 S.E. 3130 Alouette II *On order:* 4 Douglas DC-7C 5 Boeing 707-329	97,866	21,864,827 *2,633,413*	645,260 *40,830*	7,260,826 *589,582*	41,911,551 *7,584,316*	State and private interests each have 50% interest.
Société Belge de Transports par Air S.A. (SOBELAIR)	137 Rue Royale, Brussels G. Claeys A. Philippe P. Bertin J. Carlier	2 Douglas DC-4 3 Cessna 310	—	123,606 *412,171*	967 *3,148*	5,507	43,076 *72,987*	—
BOLIVIA								
Lloyd Aereo Boliviano S.A. (LAB)	Casilla 132, Cochabamba President: Edmundo Gonzalez G. Gen. Manager: Rodolfo Galindo Q.	2 Douglas DC-4 3 Douglas DC-3 7 Douglas C-47 6 Boeing B-17 *On order:* 3 Fairchild F-27	5,652	1,143,325 *1,177,098*	88,982 *11,223*	88,285 *8,325*	3,109,596 *30,358,554*	—
BORNEO	—							
Borneo Airways		2 Scottish Aviation Twin Pioneers	—	—	—	—	—	Formed in 1957 by Govmts. of Sarawak, N. Borneo and Brunei, who hold 51% interest. Remaining 49% held jointly by Malayan Airways and B.O.A.C. Operates internal services previously operated by Malayan Airways in area.

Non-scheduled traffic figures in italic type.

Airline	Head Office and Management	Fleet	Route Mileage	Miles Flown 1957	Passengers 1957	Mail (lb.) 1957	Freight (lb.) 1957	Remarks
BRAZIL								
Consórcio Real-Aerovias-Nacional-Aeronorte-TAS *Real S/A Transportes Aéreos (REAL)* President: Capt. Linneu Gomes Ops. Director: Capt. Armando Aguiar Campos *Empresa de Transportes Aerovias Brasil S/A* President: José Carlos Tolentino *Empresa de Transportes Aéreos Norte do Brasil S/A (AERONORTE)* President: Capt. Linneu Gomes *National Transportes Aéreos S/A* Man. Director: Cláudio Ricardo Hölck *Transportes Aéreos Salvador S/A (TAS)* Director: Cláudio Ricardo Hölck *Sadia S/A Transportes Aereos* President: Dr. Joaquia Peixoto Rocha	Rua Conselheiro Crispiniano, 379 - 2° andar, Sao Paulo	4 Lockheed L-1049H Super Constellation 8 Convair 440 6 Convair 340 3 Douglas DC-4 82 Douglas DC-3 16 Curtiss C-46 *On order:* 6 Convair 440 4 Convair 880	83,765	29,910,238 total	2,263,056 total	2,202,455 total	90,599,904 total	Technical and administrative agreement with Sadia S/A Transportes Aeréos signed in 1958. Statistics do not include Aeronorte and Sadia results.
Correio Aéreo Nacional	—	40 Douglas DC-3 20 Beechcraft 18 8 Beechcraft Bonanza 2 Consolidated Canso	Over 45,000 (duplicated)	—	—	—	—	Transport branch of the Brazilian Armed Forces responsible for air services in areas where commercial operations would not be justified.
Empresa de Transportes Aéreos Catarinense, S.A. (T.A.C.)	Felipe Schmidt 14, Florianopolis, Santa Catarina President: Dr. J. D. F. Lima Ops. Manager: E. Neves	Douglas DC-3's	—	—	—	—	—	Operates coastal routes from Florianopolis to Rio, Porto Alegre and Bage, with technical assistance and crews from Cruzeiro do Sul.
Lóide Aéreo Nacional S.A.	Av. 13 de Maio, 13 - 27° andar, Rio de Janeiro Marcílio Gibson Jacques Manoel Guerra Borges Anelio Gonçalves Moles	3 Douglas DC-4 15 Curtiss C-46 *On order:* 4 Douglas DC-6 3 Douglas DC-4	20,797	4,834,509 *644,958*	144,230 *5,879*	369,903 *2,535*	16,424,376 *3,554,443*	—
Navegacão Aérea Brasileira S.A. (N.A.B.)	Santos Dumont Airport, Rio de Janeiro Gen. Manager: Cmdr. G. X. de Oliveira	4 Douglas DC-3 1 Beechcraft 1 Lockheed 10A	—	—	—	—	—	Operates from Rio to Vitoria and Belo Horizonte.
Panair do Brasil S.A. (P.A.B.)	Aeroporto Santos Dumont, Praça Marechal Ancore S/no President: Manoel Ferreira Guimarães Director-Superintendent: Cesar Pires de Mello Ops. Manager: Decio Alves Vilhena	4 Douglas DC-7C 10 Lockheed Constellation 7 Douglas DC-3 7 Douglas C-47 4 Consolidated PBY-5A	—	13,626,706 *358,504*	349,736	5,109,174	18,874,737	An affiliate of Pan American World Airways which holds a 48% interest.
S.A. Empresa de Viaçao Aérea Rio Grandense (VARIG)	P.O. Box 243, Porto Alegre, RGS President: Ruben M. Berta Director Ops.: Goetz G. Herzfeldt	22 Douglas C-47 14 Curtiss C-46 10 Convair 240 5 Lockheed L-1049G Super Constellation *On order:* 5 Sud Caravelle 3 Boeing 707-441	18,656	11,264,823 *1,805,803*	497,038 *48,315*	794,787 *34,138*	39,688,116 *10,591,907*	—
S.A. Viação Aérea Gaúcha (SAVAG)	Edifício Camara do Comércio, Rio Grande do Sul President: E. C. Becker Ops. Manager: Maria C. Cramer	6 Douglas DC-3	1,143	—	—	—	—	Technical and operational assistance is given by Cruzeiro do Sul.
Serviços Aéreos Cruzeiro do Sul, Ltda. (Cruzeiro)	128, Avenida Rio Branco, Rio de Janeiro President Dr. J. B. R. Dantas Ops. Director: Col. F. A. Rocha	34 Douglas DC-3 4 Convair 440 4 Convair 340 4 Beechcraft AT-11 5 Fairchild C-82	23,902	—	468,261	527,000	21,625,000	—

Non-scheduled traffic figures in italic type.

Airline	Head Office and Management	Fleet	Route Mileage	Miles Flown 1957	Passengers 1957	Mail (lb.) 1957	Freight (lb.) 1957	Remarks
BRAZIL—*cont.*								
Viação Aerea São Paulo S.A. (VASP)	Rua Líbero Badaró, 89, São Paulo President: Oswaldo Pamplona Pinto Vice-President: Dr. José Castilho Cabral	15 Douglas DC-3/C-47 17 Saab Scandia *On order:* 5 Vickers Viscount	11,409	6,581,394	445,839	44,535	19,144,021	State of São Paulo holds 51% interest.
BRITISH CENTRAL AFRICA								
Central African Airways Corporation	Salisbury Airport, Salisbury, Southern Rhodesia Gen. Manager: Max Stuart-Shaw	5 Vickers Viscount 748 2 Vickers Viking 5 Douglas DC-3 6 D.H. Beaver	13,989	5,141,259 *644,867*	174,991 *15,254*	1,317,423 *3,285*	3,232,989 *155,041*	National airline owned by the Federation of Rhodesia and Nyasaland.
Hunting-Clan African Airways (Pvt.) Ltd.	Salisbury Airport, Salisbury, Southern Rhodesia Chairman: Charles Barnard Gen. Manager: T. P. Lawler	2 Douglas DC-3 3 D.H. Dragon Rapide	2,650	383,701 *96,569*	14,608 approx. *3,800*	1,235,469 (includes freight) approx. *105,820* (includes freight)	—	Subsidiary of Hunting-Clan Air Transport Ltd., providing connections with H.C.A. truck routes and local passenger, cargo and inclusive holiday services.
BRITISH EAST AFRICA								
Caspair Ltd.	Plant House, P.O. Box 2238, Nairobi, Kenya Directors: L. K. Campling F. K. Campling H. Vanderwal Z. Boskovic	3 D.H. 89A 1 Cessna 182 2 Beechcraft Bonanza 1 North American Navion 1 Piper Cub	1,265	141,035 *220,581*	2,154 *1,627*	10,516	35,024 *66*	—
East African Airways Corporation	Sadler House, Sadler Street, P.O. Box 30030, Nairobi, Kenya Gen. Manager: M. C. P. Mostert, O.B.E. Ops. Manager: E. E. Morris, M.V.O.	9 Douglas DC-3 4 D.H. 89 Rapide 3 Canadair DC-4M2 *On order:* 1 Canadair DC-4M2 2 D.H. Comet	22,976	2,958,000 *222,838*	114,182 *8,214*	1,004,367 *2,122*	5,122,524 *114,046*	—
BRITISH GUIANA								
British Guiana Airways (Government)	32, Main Street, Georgetown Gen. Manager: Capt. G. P. Wood	3 Douglas C-47A 3 Grumman G-21A Goose	—	—	—	—	—	Ownership and control acquired by the British Guiana Government in 1955. Operations managed by B.W.I.A.
BRITISH HONDURAS								
British Honduras Airways Ltd.	Belize Chairman: J. W. MacMillan, O.B.E. Directors: R. H. Eyles, O.B.E., J.P. T. B. Baker	2 Cessna 180	200	59,280 *75,000*	1,396 *1,305*	approx. 75	approx. 1,000	Bought assets of Airline Division of British Colonial Airlines in October, 1956.
BRITISH WEST AFRICA								
Nigerian Airways Corporation	—	—	—	—	—	—	—	Formed in 1958 to take over services previously operated by West African Airways Corporation, including internal services of Sierra Leone Airways. Government owns 51% interest. Remainder held by B.O.A.C. and Elder Dempster Lines.
Sierre Leone Airways	Freetown, Sierra Leone	3 D.H. 89 Mk. 4 Dragon Rapide	—	—	—	—	—	Formed in 1958. Operates internal services.
West African Airways Corporation	Airways House, Lagos Airport, Nigeria Chairman: R. W. C. Baker-Beall, C.B.E. Gen. Manager: D. Malcolm Brown	5 Douglas DC-3 8 D.H. 114 Heron 2 D.H. 104 Dove 1 D.H. 89A Rapide *On order:* 2 Douglas DC-3 2 D.H. 89A Rapide	7,753	2,386,856 *340,993*	73,297	1,188,094	1,826,062	Ceased operations on September 30, 1958. Domestic services in Nigeria taken over by Nigerian Airways Corporation and in Ghana by Ghana Airways on October 1.

Non-scheduled traffic figures in italic type.

Airline	Head Office and Management	Fleet	Route Mileage	Miles Flown 1957	Passengers 1957	Mail (lb.) 1957	Freight (lb.) 1957	Remarks
BRITISH WEST INDIES								
Bahamas Airways Ltd.	Box 65, Shirley Street, Nassau, Bahamas President: Sir George Cribbett, K.B.E., C.M.G. Chairman: Hon. H. G. Christie, C.B.E., M.H.A. Gen. Manager: Capt. Peter C. Fair	2 Grumman Goose 3 D.H. Heron 1 Consolidated Catalina	—	596,596 *126,094*	32,447 *2,368*	N/A *N/A*	127,720	Associated company of B.O.A.C. Figures are for year ending 31 March, 1957.
British West Indian Airways Ltd. (B.W.I.A.)	17 Chacon Street, Port of Spain, Trinidad President: Sir Gerard d'Erlanger, C.B.E. Chairman: Sir Errol dos Santos, C.B.E. Gen. Manager: J. H. Rahr	6 Vickers Viscount 702 and 754 3 Douglas DC-3 1 Vickers Viking *On order:* 2 Vickers Viscount 754 1 Douglas DC-3	9,699	1,844,116 *1,826,389*	105,902 *1,326*	488,928 *2,191*	1,365,573 *21,595*	A wholly-owned associate of B.O.A.C.
Leeward Islands Air Transport Company	St. John's, Antigua	Piper Apache	—	—	—	—	—	Operates services between Antigua, Montserrat, St. Kitts, Anguilla and Puerto Rico.
BULGARIA								
Bulgarski Vzduszni Linii (TABSO)	12, Place Narodno, Sabranie, Sofia	Ilyushin I1-14's Li-2's	—	—	—	—	—	State-owned.
BURMA								
Union of Burma Airways Board	104 Strand Road, Rangoon Gen. Manager: U. Taw	8 Douglas C-47 and DC-3 3 D.H. 104 Dove 2 Handley Page Marathon 1 Auster 5 1 Consolidated PBY-5A 1 Ilyushin I1-14 3 Vickers Viscount 761D	8,348	1,500,890 *114,861*	98,937 *5,055*	334,736 *9,229*	2,827,089 *506,873*	Controlled by a Government Board. Statistics cover period Oct. 1956—Sept. 1957.
CAMBODIA								
Royal Air Cambodge	151 Vithei Dekcho Damdin, Phnom-Penh Chairman: Huot Sam Ath Gen. Manager: Jean Florent	1 Douglas DC-3 1 Boeing B.307	1,565	261,199 *23,848*	17,300 *513*	41,328	221,646 *14,839*	—
CANADA								
Canadian Pacific Air Lines, Ltd. (C.P.A.L.)	Vancouver Airport, B.C. President: G. W. G. McConachie Exec. Vice-President: R. W. Ryan Vice-President (Ops.): R. B. Phillips	11 Douglas DC-6B 11 Douglas DC-3 5 Convair 240 6 Curtiss C-46F 1 Convair Canso 2 DHC-3 Otter *On order:* 4 Douglas DC-6B 6 Bristol Britannia 314	40,609	13,926,654	279,916	3,222,186	12,833,394	Wholly-owned subsidiary of Canadian Pacific Railway Company.
Leavens Bros. Ltd.	3220 Dufferin Street, Toronto 19, Ontario President and Gen. Manager: C. R. Leavens	3 Cessna T-50	76	63,751 *451*	3,596 *1*	75,354	63,656	—
Maritime Central Airways Limited	Charlottetown, Prince Edward Island President: F. T. Briggs Man. Director: C. F. Burke Ops. Manager: H. S. Jones	7 Douglas DC-3 3 Douglas DC-4 3 Curtiss C-46 1 D.H. Beaver 3 Beechcraft C18S *On order:* 2 Douglas DC-6B	1,081	706,066 *3,407,194*	36,290 *24,109*	1,209,732	1,303,007 *15,622,837*	—
Matane Air Services Limited	Box 700, Matane, Quebec President: G. Burnett Secretary-Treasurer: E. Burnett	4 Lockheed Electra (piston-engined) 1 Cessna T-50	234	277,321 *11,955*	25,578 *745*	6,714	237,807	—
Northern Wings Limited	Northern Wings Helicopters Limited Seven Islands, Quebec President: Jos. Cauchon Vice-President: Jean Brown Gen. Manager: W. G. McElrea	1 Curtiss C-46 1 Douglas DC-3 2 Consolidated Canso 4 D.H. Beaver 2 D.H. Otter 2 Noorduyn Norseman 1 Cessna 180 3 Bell 47G2	—	— *237,432*	— *9,885*	— *450,619*	— *6,742,505*	—

Non-scheduled traffic figures in italic type.

Airline	Head Office and Management	Fleet	Route Mileage	Miles Flown 1957	Passengers 1957	Mail (lb.) 1957	Freight (lb.) 1957	Remarks
CANADA—*cont.*								
Pacific Western Airlines, Ltd.	Vancouver Airport, B.C. President and Gen. Manager: R. Baker Ops. Manager (IFR): J. F. Crosby Ops. Manager (VFR): A. J. Moul	2 Douglas DC-4 2 Avro York 2 Curtiss C-46 5 Douglas DC-3 3 Consolidated Canso 2 Grumman Mallard 7 Avro Anson 3 Barkley-Grow 23 D.H. Beaver 3 D.H. Otter 12 Noorduyn Norseman 8 Cessna 180 8 Bell 47 Plus miscellaneous types to total 93	6,750	1,882,110 *3,827,463*	112,291 *42,111*	195,292	465,280 *6,387,287*	Took over Queen Charlotte Airlines Ltd. in 1955 and Associated Airways early in 1956.
Quebecair Inc.	Rimouski, Quebec President: Romeo Crevier Vice-Presidents: Aubert Brillant Maurice Tessier	8 Douglas DC-3 2 Convair Catalina 1 Beechcraft D-18S *On order:* 2 Fairchild F-27	1,613	1,246,997 *31,315*	149,454	912,678 total	3,695,455 total	—
Saskatchewan Government Airways	Box 850, Prince Albert, Saskatchewan Gen. Manager: Ian McLeod Ops. Manager: F. R. Baudais	2 Douglas DC-3 1 D.H. Otter 5 D.H. Beaver 1 Cessna 170 4 Noorduyn Norseman 9 Cessna 180 1 Cessna 140 1 Piper Super Cub	—	— *1,348,647*	— *17,748*	— *107,450*	— *5,582,864*	—
Transair Limited	No. 5 Hangar, Stevenson's Field, St. James, Winnipeg 12, Manitoba Chairman: G. H. Sellers President and Man. Director: R. D. Turner Vice-President: A. G. Bailey	2 Avro Anson 3 D.H. Beaver 1 Bellanca 4 Convair Canso 4 Cessna 3 Douglas DC-3 1 Douglas DC-4 1 Lockheed 12A 13 Noorduyn Norseman 1 Avro York	12,869	889,813 *1,507,817*	19,556 *15,696*	401,567	1,649,110 *12,438,161*	In September 1957, Transair acquired Class 1 and 2 scheduled services in Manitoba formerly operated by Canadian Pacific Air Lines.
Trans-Canada Air Lines (T.C.A.)	International Aviation Building, Montreal, P.Q. President: G. R. McGregor Vice-President (Ops.): H. W. Seagrim	21 Canadair DC-4M2 11 Lockheed Super Constellation 15 Vickers Viscount 724 16 Vickers Viscount 757 18 Douglas DC-3 *On order:* 20 Vickers Viscount 757 20 Vickers Vanguard 950 6 Douglas DC-8	27,000	44,000,000 *N/A*	2,375,000 *N/A*	21,500,000 *N/A*	30,000,000 *N/A*	Canada's "national" airline, an autonomous, publicly-owned company.
Wheeler Air Lines Ltd.	St. Jovite Station, Quebec President: F. H. Wheeler Man. Director: B. Rychlicki Gen. Manager: D. Mellship	3 Douglas DC-4 4 Douglas DC-3 2 Curtiss C-46 2 Consolidated PBY-5A 1 Beechcraft D-18 2 Sikorsky S-55 2 D.H. Otter 3 D.H. Beaver 5 Noorduyn Norseman 1 Cessna 180 7 Stearman 450 3 Sikorsky S-51 *On order:* 2 Fairchild F-27	562	540,000 *2,730,000*	N/A *N/A*	N/A *N/A*	N/A *N/A*	Operations largely Northern and Transatlantic charter. Other operations include helicopter and forest spraying.
CEYLON								
Air Ceylon Limited	Hemas Building, York Street, Colombo 1 Man. Director: J. L. M. Fernando Deputy Man. Director: F. G. A. van Moll	2 Douglas DC-3 1 Lockheed Constellation (leased from K.L.M.)	8,785	1,276,653	43,563	108,621	1,244,312	—
CHILE								
Ala y Cinta	Santiago	Lockheed Constellations Douglas DC-4's Curtiss C-46 Commandos	—	—	—	—	—	Merger of Sociedad de Transportes Aereos (ALA) Ltda. and Cinta-Linea Aerea Chilena. Has taken over all services previously operated by constituent companies.

Non-scheduled traffic figures in italic type.

Airline	Head Office and Management	Fleet	Route Mileage	Miles Flown 1957	Passengers 1957	Mail (lb.) 1957	Freight (lb.) 1957	Remarks
CHILE—*cont.*								
Cía. Nacional de Transporte Aéreo Cinta S.A.	Agustinas 1225, 70, piso, Santiago President: A. Edwards Vice-President: G. Prieto Gen. Manager: J. Claro	5 Douglas DC-4 3 Curtiss C-46 2 Douglas DC-3 2 Lockheed 10A 2 Beechcraft Bonanza	6,867	555,737 *34,654*	19,221 *318*	3,236	1,115,673 *36,314*	Formed to operate low-fare services between Santiago and Miami, via Arica, Talara and Panama.
Línea Aérea Nacional-Chile (LAN)	Los Cerrillos Airport, Santiago Vice-President: A. Fernandez Technical Man.: R. Salas Ops. Manager: P. Puga	2 Lockheed 10A 1 Beechcraft Bonanza 17 Douglas DC-3 (1 hired) 4 Martin 202 3 Douglas DC-6B *On order:* 4 Douglas DC-6B	15,086	5,240,538 *197,955*	310,162	284,491	9,090,839	State-owned.
CHINA								
Minhaiduy Civil Aviation Administration of China (CAAC)	15 Ch'ang Am Street (East), Peking	Ilyushin I1-14's Ilyushin I1-12's Li-2's	Approx. 9,500	—	—	—	—	Successor to joint Soviet-Chinese airline Skoga. Operates internally and to Irkutsk and Mukden.
COLOMBIA								
Aeravios Nacionales de Colombia (Avianca)	Carrera 7a, No. 16-14, Bogota President: J. G. R. Jaramillo Exec. Vice-President: J. P. Martinez Vice-President: (Technical): Refael Barvo G.	4 Lockheed Super Constellation 12 Douglas C-54 22 Douglas DC-3 9 Douglas C-47 (*Avianca*) 18 D.H. Beaver and Cessna (*Aerotaxi*) 10 Bell 47 (*Helicopteros de Columbia*)	24,043	14,232,855 total	1,082,776 total	1,375,367 total	158,529,707 total	Aerotaxi and Helicopteros de Colombia are subsidiaries. Pan American holds 38.37% interest.
Lloyd Aero Colombiano (LAC)	Bogotá	Curtiss C-46's Douglas DC-3's Cessna 310's	—	—	—	—	—	In liquidation.
RAS Rutas Aéreas de Colombia Ltda.	Edificio del Café, Medellín Gen. Manager: Dr. Joaquín Londoño O. Ops. Manager: Max Miller	3 Douglas DC-4B 2 Douglas C-47A 1 Douglas DC-3 *On order:* 3 Lockheed L-749 Constellation	7,922	1,577,738	138,000	—	320,000	—
Sociedad Aeronautica Medellín S.A. (SAM)	Calle 51, 53-34, Medellín Gen. Manager: Pedro A. Mena V. Ops. Manager: Capt. Jorge Bernal	5 Curtiss C-46 2 Douglas C-47	12,123	— *1,626,811*	— *3,044*	— *5,014,283*	— *49,266,793*	—
Uraba, Medellin and Central Airways, Inc. (UMCA)	320 Caraboba, Medellin President: E. Balluder	1 Douglas DC-3	328	—	—	—	—	Aircraft leased from Pan American World Airways, which has a substantial interest in UMCA.
COSTA RICA								
Lineas Aéreas Costarricenses S.A. (LACSA)	P.O. Box 1531, Avenida la, Calle Central, San José President: F. Terán Gen. Manager: Francisco Bonilla	2 Convair 340 4 Curtiss C-46 3 Douglas DC-3	4,439	—	—	—	—	Purchased outright by State in 1958.
CUBA								
Aerovias "Q" S.A.	Cienfuegos 70, Havana President and Gen. Manager: Manuel Quevedo Ops. Manager: J. E. Alvarez Regato	4 Curtiss C-46 2 Douglas DC-4	980	566,600 *24,236*	132,507 *114*	508,430	831,296	—
Compañía Cubana de Aviación, S.A. (CUBANA)	Jose Marti International Airport, Rancho Boyeros, Havana President and Chairman: José López Vilaboy	3 Lockheed L-1049G Super Constellation 1 Lockheed L-049 Constellation 6 Douglas DC-3 3 Vickers Viscount 755D 1 Curtiss C-46 (leased to Carga por Avion) *On order:* 2 Bristol Britannia 318 4 Vickers Viscount 818 2 Boeing 707-139	11,301	5,081,978 *262,976*	325,243	150,995 ton-miles	1,374,334 ton-miles	—

Non-scheduled traffic figures in italic type.

Airline	Head Office and Management	Fleet	Route Mileage	Miles Flown 1957	Passengers 1957	Mail (lb.) 1957	Freight (lb.) 1957	Remarks
CUBA —*cont.*								
Expreso Aereo Inter-Americano, S.A. (Expreso)	Apartado No. 722, Havana President: Gerardo Díaz Gongález	3 Curtiss C-46	467	—	—	—	—	Official airmail carrier.
CYPRUS								
Cyprus Airways Ltd.	16 Byron Avenue, Nicosia Chairman: Dr. C. Raeburn, C.B.E., D.Sc. Gen. Manager: P. Holroyd Smith, O.B.E.	4 Douglas DC-3	2,526	806,660 *52,455*	35,832 *N/A*	842,827 *N/A*	1,381,856 *N/A*	Jointly owned by B.E.A., B.O.A.C., Government of Cyprus and Cypriot citizens.
CZECHOSLOVAKIA								
Ceskoslovenské Aerolinie (C.S.A.)	I Namesti Republiky, Prague Gen. Manager: Josef Procházka Deputy Gen. Manager: Al. Palichleb	3 Tupolev Tu-104A 10 Ilyushin I1-14 7 Ilyushin I1-12 7 Li-2 21 Douglas DC-3	—	—	270,650	11,499,000	2,923,000	State-owned.
DENMARK								
Det Danske Luftfartselskab A/S. (D.D.L.)	Dagmarhus, Copenhagen V. Chairman: Per Kampmann President: H. Bech-Bruun	—	—	—	—	—	—	A non-operating holding company in the SAS consortium. See under "Scandinavia."
DOMINICAN REPUBLIC								
Compañia Dominicana de Aviacion, C. por A.	"General Andrews" Airport, Ciudad Trujillo President: C. A. McLaughlin Ops. Manager: J. Martinez Richiez	2 Douglas DC-3 2 Curtiss C-46 3 Curtiss C-46 (freight) 1 D.H. Beaver 1 Douglas DC-4 *On order:* 1 Douglas DC-4	1,648	1,062,913 total	30,355 total	7,128	3,171,001 total	Pan American World Airways has a 40% interest.
ECUADOR								
Aerovias Ecuatorianas (A.R.E.A.)	661 Calle Garcia Moreno, P.O. Box 2226, Quito President: Luis Arias Gen. Manager: A. Arias	2 Boeing B.377 3 Douglas DC-3 1 Douglas C-47 5 Avro Anson 3 Ryan Navion *On order:* 1 Fairchild F-27	3,533	—	—	—	—	—
EGYPT								
Misrair S.A.E.	Almaze Airport, Heliopolis Gen. Manager: A/Cdre. Mahmoud Sedki El Meligi	2 Vickers Viscount 739 7 Vickers Viking 1B 2 Douglas DC-3 1 Beechcraft D18S *On order:* 2 Vickers Viscount 739	9,205	2,075,467 *230,322*	91,856	181,484	2,907,604	—
EL SALVADOR								
Taca International Airlines, S.A.	San Salvador President and Gen. Manager: Ricardo H. Kriete Vice-President—Traffic: J. Dan Brock Vice-President—Ops.: R. Clipson	1 Vickers Viscount (leased from Philippine Airlines) 3 Douglas DC-4 1 Curtiss C-46 (cargo) *On order:* 2 Vickers Viscount	3,860	1,726,358	41,158	9,773,651	144,526	A subsidiary of the TACA Corporation, Alabama, U.S.A.
ETHIOPIA								
Ethiopian Airlines, Inc.	P.O. Box 1755, Addis Ababa President and Chairman: H. E. Dejazmatch Zewde Gebre Selassie Ops. Manager: H. F. Noon	8 Douglas DC-3 and C-47 3 Convair 240 2 Bell 47J 1 Bell 47G *On order:* 3 Douglas DC-6B	—	2,973,530 *223,910*	87,605 *1,818*	232,257	11,626,493 *4,060,430*	—
FIJI ISLANDS								
Fiji Airways	Victoria Arcade, Suva Manager: R. O. Mant Asst. Manager: Leonard Dobbin	3 D.H. A3 Drover	561	462,896	21,247	130,786	297,058	Taken over by Qantas on March 24, 1958.
FINLAND								
Aero O/Y (FINNAIR)	Töölönkatu 4, Helsinki President: Lt. Gen. L. Grandell	6 Convair 440 10 Douglas DC-3 *On order:* 3 Sud Caravelle	10,682	5,774,887 *107,527*	385,147 *4,437*	1,409,619 *35,662*	3,614,736 *7,059*	State owns 73% interest.
Kar-Air O/Y	Lönnrotinkatu 3, Helsinki Chairman: Niilo Karhumäki President: Uuno Karhumäki	2 Convair 440 3 Douglas DC-3 1 Lockheed Lodestar	1,720	413,200 *341,544*	24,624 *12,369*	49,792 *106,080*	92,526	—

Non-scheduled traffic figures in italic type.

Airline	Head Office and Management	Fleet	Route Mileage	Miles Flown 1957	Passengers 1957	Mail (lb.) 1957	Freight (lb.) 1957	Remarks
FRANCE								
Compagnie de Transports Aeriens Intercontinentaux (T.A.I.)	23 Rue de la Paix, Paris 2e Chairman: Paul Bernard Gen. Manager: General Georges Fayet	3 Douglas DC-7C 4 Douglas DC-6B 1 Douglas DC-6 2 Douglas DC-4 3 Douglas DC-3 *On order:* 3 Douglas DC-8	47,850	6,179,200	62,751	714,297	3,223,534	—
Compagnie Nationale Air France (Air France)	2 Rue Marbeuf, Paris, 8e Chairman: Max Hymans President: Louis Lesieux	8 Lockheed L-1649A Starliner 22 Lockheed L-1049 Super Constellation 16 Lockeed L-749 Constellation 11 Vickers Viscount 708 12 Breguet Provence 22 Douglas DC-4/C-54 39 Douglas DC-3 *On order:* 2 Lockheed L-1649A Starliner 24 Sud Caravelle 17 Boeing 707-328	177,100	48,350,000 *2,038,000*	2,388,684 *60,646*	36,511,000 *220,530*	111,732,000 *15,920,000*	—
Lignes Aériennes Intérieures (Air-Inter)	96 Boulevard Haussmann, Paris 8e President Director-General: René Lemaire	—	—	—	—	—	—	Began domestic operations in March, 1958.
Société Auxiliaire de Gérance et de Transports Aériens (S.A.G.E.T.A.)	12 Boulevard de la Madeleine, Paris 9 President: Général Pierre Marette	6 S.E. 2010 Armagnac	—	1,258,891	82,171	—	3,561,643	—
Union Aéromaritime de Transport (U.A.T./Aéromaritime)	5 Boulevard Malesherbes, Paris 8e President Director-General: L. Pommery Directors: J. Combard R. Loubry	7 Douglas DC-6 1 Douglas DC-4 8 D.H. Heron 4 Nord 2502 Noratlas *On order:* 5 Nord 2502 Noratlas 2 Douglas DC-6 2 Douglas DC-8	50,330	7,116,752 *816,315*	10,386 *21,259*	1,313,350 *180,054*	21,312,139 *812,336*	—
FRENCH EQUATORIAL AFRICA								
Transports Aériens du Gabon	P.O. Box 161, Libreville, Gabon	4 D.H. 89 Rapide 4 Cessna 170B 2 Auster Autocrat 1 Percival Proctor 5	—	—	—	—	—	This company began operations in 1951 and now links all surrounding places with Libreville.
FRENCH GUIANA								
Société Aérienne des Transports Guyane-Antilles (SATGA)	Cayenne	D.H. 89 Rapide Vultee L-13	57	—	—	—	—	Flies local services in French Guiana.
GERMAN DEMOCRATIC REPUBLIC								
Deutsche Lufthansa	Franzosische Strasse 53-56, Berlin W.8 Director-General: Arthur Pieck Traffic Director: Fritz Horn	Ilyushin I1-14P's Antonov An-2's Super Aero 45's Avia L-60 Brigadyrs *On order:* Type 152 jet airliners	—	—	—	—	—	International air traffic since 1956. Domestic air traffic since 1957.
GERMAN FEDERAL REPUBLIC								
Aerotour-Deutsche Luftreederei	Alstertor 14-16	2 Vickers Viking	—	—	—	—	—	Charter operator.
Condor Luftreederei G.m.b.H.	Hamburg Acting Manager: Harry G. Howell Chief of Ops.: Capt. Richard Mergelsberg	*On order:* 2 Convair 440	—	—	—	—	—	Independent charter carrier. Began operations July, 1958.
Deutsche Flugdienst G.m.b.H.	Burogebaude Ost, Flughafen, Frankfurt (Main) Man. Director: E. von Brauchitsch	4 Vickers Viking 5 Convair	—	— *1,149,660*	—	—	—	Began charter operations on April 1, 1956. Aircrew and maintenance staff provided by Airwork Ltd.
Deutsche Lufthansa Aktiengesellschaft	Claudiusstrasse 1, Cologne Hans M. Bongers Gerhard Höltje	8 Lockheed L-1049G Super Constellation 4 Lockheed L-1649A Starliner 9 Convair 440 3 Douglas DC-3 *On order:* 9 Vickers Viscount 814 4 Boeing 707-430	37,788	9,923,410 *77,238*	380,862 *N/A*	3,406,868 *N/A*	7,345,093 *N/A*	—

Non-scheduled traffic figures in italic type.

Airline	Head Office and Management	Fleet	Route Mileage	Miles Flown 1957	Passengers 1957	Mail (lb.) 1957	Freight (lb.) 1957	Remarks
GERMAN FEDERAL REP.—*cont.*								
Lufttransport Unternehmen G.m.b.H.	Frankfurt Airport Managers: P. Lauxen W. Sachsenberg E. von Manteuffel	3 Douglas DC-4 2 Vickers Viking 1 Bristol Wayfarer Mk. 21 1 D.H. Dove 1 Cessna 310	—	— *1,275,075*	— *19,800*	—	— *2,296,000*	—
Trans-Avia Fluggesellschaft	Dusseldorf Airport	2 Douglas DC-4 5 Vickers Viking	—	—	—	—	—	Charter operator.
GHANA								
Ghana Airways, Ltd.	Accra	—	—	—	—	—	—	Formed on July 4, 1958, to operate international services and domestic services previously operated by W.A.A.C. Government of Ghana have 60% interest, remaining 40% held by B.O.A.C. Associated Companies, Ltd. Began operations between Accra and London on July 16 with equipment chartered from B.O.A.C. and W.A.A.C., domestic services in Ghana on October 1, 1958.
GIBRALTAR								
Gibraltar Airways, Ltd.	Cloister Building, Irish Town Gibraltar Chairman: Sir George Gaggero, O.B.E., J.P.	1 Douglas DC-3 (owned by B.E.A.)	45	—	—	—	—	B.E.A. holds 51% interest. M. H. Bland & Co. Ltd. 49%. Service operated by B.E.A.
GREAT BRITAIN								
Air Charter Ltd.	21 Wigmore Street, London, W.1 Man. Director: F. A. Laker Director: J. M. Laker Chief Pilot and Ops. Manager: E. N. Jennings	3 Douglas DC-4 6 Avro Super Trader 9 Bristol 170	660	576,338 *3,623,676*	42,339 *37,116*	—	3,874,582 *2,892,000*	Airwork acquired substantial interest in 1958.
Air Couriers (Transport) Ltd.	Croydon Airport, Surrey Directors: C. P. L. Godsal F. W. Griffith	3 D.H. Dragon Rapide 2 Miles Gemini 1 Airspeed Oxford	—	—	—	—	—	Contract charter—mainly television and press work.
Airviews Ltd.	Manchester Airport Directors: J. B. Martin B. M. Martin	2 D.H. 89A 1 D.H. 104 Dove 1 Auster	1,100	43,000 *50,000*	43,000 *35,000*	—	— *15,000*	Scheduled services from Manchester and extensive commercial aerial photography.
Airwork Ltd.	Airwork House, 35 Piccadilly, London, W.1 Chairman and Man. Director: M. D. N. Wyatt, C.B.E. Gen. Manager: W. K. Davison Ops. Manager: G. E. Ford	2 Vickers Viscount 736 4 Handley Page Hermes 4 5 Vickers Viking numerous smaller aircraft *On order:* 2 Vickers Viscount 831	15,000	1,298,852 *2,500,762*	7,008 *33,692*	—	—	In addition, Airwork operates 7 Douglas C-47's and 4 D.H. Doves on behalf of Sudan Airways, and 5 D.H. Doves on behalf of the Iraq Petroleum Co. Subsidiaries, with own aircraft, include Transair, Fison-Airwork and Straits Air Freight Express, New Zealand.
British Aviation Services Ltd.	Silver City House, 62, Brompton Road, London, S.W.3 Chairman: Eoin C. Mekie, C.B.E. Gen. Manager: Air Vice-Marshal S. D. MacDonald C.B., C.B.E., D.F.C. *Silver City Airways* (Southern Division) Commercial Director: W. G. Franklin Regional Director: H. C. Kennard *Britavia* Division Manager: W. Hogsflesh	14 Bristol 17 Freighter Mk. 32 7 Bristol 170 Freighter Mk. 21 3 Short Solent 5 Handley Page Hermes 4 2 D.H. Heron 7 Douglas DC-3/Dakota 1 Airspeed Consul 1 Douglas DC-2 3 D.H. Dragon Rapide	23,440	2,509,016 *2,235,332*	343,133 *33,622*	69,840	128,097,760 *2,496,500*	Statistics cover activities of Silver City Airways, Britavia and Aquila Airways.

Non-scheduled traffic figures in italic type.

Airline	Head Office and Management	Fleet	Route Mileage	Miles Flown 1957	Passengers 1957	Mail (lb.) 1957	Freight (lb.) 1957	Remarks
GREAT BRITAIN —*cont.*								
B.K.S. Air Transport Ltd.	1 Marylebone High Street, London, W.1 Man. Director: C. J. Stevens Commercial Manager: A. Selby Lowndes	4 Douglas C-47A Dakota 1 Airspeed Ambassador *On order:* 2 Airspeed Ambassador	2,462	843,818 *370,100*	56,075 *9,895*	—	249,774 *57,887*	—
British European Airways Corporation (B.E.A.)	Keyline House, Ruislip, Middlesex Chairman: Lord Douglas of Kirtleside Chief Executive: Anthony H. Milward	1 Vickers Viscount 806 22 Vickers Viscount 802 25 Vickers Viscount 701 14 Airspeed Ambassador 38 Douglas DC-3 8 Douglas DC-3 (Freighter/Passenger) 3 D.H. 89A Rapide 2 D.H. 114 Heron 2 Westland W.S.55 1 Bristol 171 Mark 3A 1 Bell 47 B3 *On order:* 17 Vickers V.806 Viscount 20 Vickers V.951 Vanguard 6 D.H. Comet 4B 24 D.H. 121	32,600	32,425,000 *248,000*	2,751,721	15,064,000	48,686,000	State-owned.
British Overseas Airways Corporation (B.O.A.C.)	London Airport, Hounslow, Middlesex Chairman: Sir Gerard d'Erlanger, C.B.E. Deputy Chairman: Sir George Cribbett, K.B.E., C.M.G. Man. Director: Basil Smallpeice	15 Bristol Britannia 102 4 Bristol Britannia 312 10 Douglas DC-7C 16 Boeing Stratocruiser 5 Lockheed L-749A Constellation 17 Canadair Argonaut *On order:* 14 Bristol Britannia 312 19 de Havilland Comet 4 15 Boeing 707-436 35 Vickers V.C.10	79,186	40,174,819 *1,858,199*	459,829 *17,777*	8,260,000 total	18,063,000 total	State-owned.
Cambrian Airways Ltd.	Cardiff (Rhoose) Airport, Glamorgan Chairman: J. H. Watts Joint Man. Directors: L. B. Elwin W. W. Stanley	2 Douglas DC-3 3 D.H. Heron 1 D.H. Rapide	1,612	—	—	—	—	—
Dan-Air Services Ltd.	Bilbao House, 36/38 New Broad Street, London, E.C.2 Directors: F. E. F. Newman, M.C. J. W. Davies E. O. Wallis Gen. Manager: L. E. Moore	5 Avro York 2 Bristol 170 Mk. 31 2 Douglas Dakota	—	—	—	—	—	—
Derby Aviation Ltd.	78 Buckingham Gate, London, S.W.1 Directors: G/Capt. C. A. B. Wilcock, O.B.E., A.F.C.	3 Douglas Dakota 3 Handley Page Marathon	12,012	931,810 *35,887*	40,844 *2,484*	—	— *24,800*	—
Don Everall (Aviation) Ltd.	Elmdon Airport, Birmingham Directors: D. Everall C. Everall Ops. Manager: A. D. Atkinson	1 Douglas Dakota 4 3 D.H. Rapide 1 Miles Messenger	2,940	114,500 *3,200*	10,500 *85*	—	—	—
Eagle Airways of Britain (Eagle Airways Ltd.)	Marble Arch House, 40 Edgware Road, London, W.2 Chairman and Man. Director: H. Bamberg	Shares aircraft of Eagle Aviation Ltd.	3,915	425,892	16,317	5,780	79,520	—

Non-scheduled traffic figures in italic type.

Airline	Head Office and Management	Fleet	Route Mileage	Miles Flown 1957	Passengers 1957	Mail (lb.) 1957	Freight (lb.) 1957	Remarks
GREAT BRITAIN —*cont.*								
Eagle Aviation Ltd.	Marble Arch House, 40 Edgware Road, London, W.2 Chairman and Man. Director: H. Bamberg	17 Vickers Viking 1 Vickers Viscount 805 *On order:* 1 Vickers Viscount 805	N/A	— *2,201,000*	— *101,936*	—	— *96,000*	Statistics for year 1st July, 1956—31st June, 1957.
East Anglian Flying Services Ltd. (Channel Airways)	Southend Airport, Southend-on-Sea, Essex Man. Director: S/Ldr. R. J. Jones, A.F.C. Chief Pilot and Ops. Manager: S. M. P. Walsh	5 D.H. Dove 2 Bristol 170 Freighter 2 D.H. Dragon Rapide 2 Auster 1 D.H. Tiger Moth 1 Percival Proctor *On order:* 2 Vickers Viking	1,200	700,000 *50,000*	30,000 *2,000*	—	90,000 *727,822*	—
Hunting-Clan Air Transport Ltd.	London Airport, Hounslow, Middlesex Man. Director: M. H. Curtis	3 Vickers Viscount 732 9 Vickers Viking 3 Avro York 3 Douglas Dakota *On order:* 2 Douglas DC-6A 2 Bristol Britannia 317 3 Vickers Viscount 833	20,011	2,340,258 *817,809*	8,538 *34,996*	4,800	2,006,740 *315,020*	A subsidiary of Hunting-Clan Air Holdings Ltd. operating scheduled passenger services to East, Central and West Africa, and scheduled all-cargo service to Africa.
Independent Air Travel, Ltd.	Bournemouth (Hurn) Airport, Christchurch, Hants. Chairman and Man. Director: M. K. Kozubski Technical Director: D. M. Ebbutt	2 Douglas DC-4 6 Vickers Viking 1 Beechcraft 1 Percival Proctor	—	—	—	—	—	Independent operator, engaged on charter flying.
Jersey Airlines (Jersey) Ltd.	States Airport, Jersey Chairman and Man. Director: M. L. Thomas Ops. Manager: B. W. Gardiner	7 D.H. 114 Heron 1 Bristol Wayfarer	3,033	—	—	—	—	—
Morton Air Services Ltd.	Croydon Airport, Croydon, Surrey Directors: T. W. Morton E. V. W. Morton	1 D.H. Heron 7 D.H. Dove 2 Airspeed Consul 3 D.H. Dragon Rapide *On order:* 2 D.H. Heron	—	—	—	—	—	—
Olley Air Service Ltd.	Croydon Airport, Croydon, Surrey Directors: T. W. Morton E. V. W. Morton J. J. Fargher	Shares fleet of Morton Air Services Ltd.	—	—	—	—	—	—
Orion Airways, Ltd.	Blackbushe Airport, Camberley, Surrey Chairman and Man. Director: Capt. A. V. Donati	2 Vickers Viking	—	—	—	—	—	Independent operator. Formed in 1957.
Scottish Airlines (Prestwick) Ltd.	Prestwick Airport, Ayrshire Director and Gen. Manager: Capt. I. C. Grant	1 Scottish Aviation Twin Pioneer 2 Avro York 1 Douglas DC-3 *On order:* 5 Scottish Aviation Twin Pioneer	194	44,814 *922,300*	11,862 *2,547*	—	— *3,238,000*	—
Skyways Ltd.	7 Berkeley Street, London, W.1 Chairman: Sir Wavell Wakefield, M.P. Man. Director: E. Rylands Head Ops.: Capt. J. Michie	14 Avro York 9 Handley Page Hermes 4 4 Douglas DC-3 2 Airspeed Consul 1 D.H. 89 Dragon Rapide 1 Auster	39,376	15,324,193 passenger-miles *4,877,984* passenger-miles	96,024 *N/A*	—	13,661.9 ton-miles	The Bibby Line has a 49% interest in Skyways.
Starways Ltd.	Liverpool Airport, Liverpool 19 Chairman: F. H. Wilson Director: J. A. Wilson Traffic Manager: J. M. Kent	3 Douglas DC-3 2 Douglas DC-4	—	610,192 *789,162*	21,180 *7,692*	—	40,000	—
Transair Ltd.	Gatwick Airport, Surrey Chairman and Man. Director: G. H. Freeman Ops. Manager: C. W. H. Bebb	11 Douglas DC-3 2 Vickers Viscount 804 *On order:* 1 Vickers Viscount 804	—	—	—	—	—	Owned by Airwork Ltd. since August, 1956.

Non-scheduled traffic figures in italic type.

Airline	Head Office and Management	Fleet	Route Mileage	Miles Flown 1957	Passengers 1957	Mail (lb.) 1957	Freight (lb.) 1957	Remarks
GREECE								
Olympic Airways S.A.	6 Othonos Street, Athens Chairman: G. Patronicolas Gen. Manager: S. Damaskinos Ops. Manager: M. Sotiriou	1 Douglas DC-4 14 Douglas DC-3 1 Fairchild Argus *On order:* 3 Douglas DC-6B 2 Douglas DC-8	5,467	2,589,852 *41,201*	207,714	326,284	2,938,759	This company took over on April 6, 1957, the domestic and international services hitherto operated by National Greek Airlines, TAE. Statistics for period April 6 - December 31, 1957.
GUATEMALA								
Empress Guatemalteca de Aviación (Aviateca)	Aeropuerto La Aurora, Ciudad de Guatemala, C.A. President: Colonel Oscar Morales Lopez Ops. Manager: Colonel Jorge Ruiz Mendoza Director Int'l. Ops.: Colonel P. A. Alfredo Castañeda D.	5 Douglas DC-3 2 Curtiss C-46 (freight) 1 Douglas DC-4 1 Fairchild C-82 *On order:* 1 Douglas DC-4	8,365	1,600,000 *21,428*	58,973 *7,303*	29,127	15,514,821 *2,610,000*	State-owned.
HAITI								
Compagnie Haitienne de Transport Aérien (COHATA)	Port au Prince	Boeing B.307's Douglas DC-3's	869	—	—	—	—	This new company has taken over the domestic services operated formerly under the control of the Air Corps.
HAWAIIAN ISLANDS								
Hawaiian Airlines Ltd.	Honolulu International Airport, P.O. Box 3287, Honolulu 1 President: A. D. Lewis	5 Convair 340 8 Douglas DC-5 *On order:* 1 Douglas DC-6C	412	2,989,956 *35,634*	440,960 *8,214*	547,800	19,486,392 *276,839*	—
Trans-Pacific Airlines, Ltd. (T.P.A. Aloha Airline)	36 S. King Street, Honolulu President: Dr. Hung Wo Ching Executive Vice-President: D. A. Benz	8 Douglas DC-3	371 —	1,753,597 *23,443*	219,174 *3,630*	273,457	1,767,545	—
HONDURAS								
Servicio Aereo de Honduras S.A. (SAHSA)	Avenide Colon 4a. Calle, Tegucigalpa, D.C. President: R. Zelaya R. Vice-President: J. Octavio Duron	6 Douglas DC-3	2,644	—	—	—	—	—
TACA de Honduras	Tegucigalpa, D.C. President: A. Rodriguez	Douglas DC-3's	—	—	—	—	—	Subsidiary of Servicio Aereo de Honduras, S.A., but operates as separate company.
Transportes Aéreos Nacionales S.A. (T.A.N.)	Edificio Marichal, Tegucigalpa, D.C. President: Miguel Brooks	3 Curtiss C-46 (Passenger) 3 Curtiss C-46 (Freight)	4,890	—	—	—	—	—
HONG KONG								
Cathay Pacific Airways, Ltd.	1 Connaught Road, Central, Hong Kong Chairman: W. C. G. Knowles Man. Director: H. J. C. Browne	1 Douglas DC-6 1 Douglas DC-4 1 Douglas DC-3 *On order:* 1 Douglas DC-6B 2 Lockheed Electra	9,665	1,642,117 *106,182*	41,653 *1,308*	474,765	1,273,694	—
Hong Kong Airways Ltd.	Alexandra House, Hong Kong Chairman: H. D. M. Barton Gen. Manager: Capt. R. S. Colvin	2 Vickers Viscount 760	3,095	618,977 *4,391*	17,619 *191*	25,221	181,381 *513*	—
HUNGARY								
Magyar Légikozlekedési Vállalet (Hungarian Air Transport—MALEV)	Vörösmarty tér 5, Budapest V.	10 Li-2	1,848	—	—	—	—	State-owned.
ICELAND								
Flugfélag Islands H.F. (Icelandair)	Reykjavik Airport Gen. Manager: Orn O. Johnson Secretary: Sigurdur Matthiasson	2 Vickers Viscount 759 1 Douglas DC-4 3 Douglas DC-3 2 Convair Catalina	4,567	2,121,357 total	80,504 total	406,091 total	3,520,778 total	—

Non-scheduled traffic figures in italic type

Airline	Head Office and Management	Fleet	Route Mileage	Miles Flown 1957	Passengers 1957	Mail (lb.) 1957	Freight (lb.) 1957	Remarks
ICELAND—*cont.*								
Loftleidir H.F. (Icelandic Airlines)	Reykjanesbraut 6, Reykjavik Chairman: K. Gudlaugsson Gen. Manager: A. Elíasson	4 Douglas DC-4 (1 on charter)	12,645	2,180,435	24,919	66,646	517,083	—
INDIA								
Air-India International Corporation	New India Assurance Building, Majatma Gandhi Road, Fort Bombay-1 Chairman: J. R. D. Tata Vice-Chairman: and Gen. Manager: B. R. Patel Technical Director: A. C. Gazdar	1 Lockheed L-1049G Super Constellation 5 Lockheed L-1049E Super Constellation 1 Douglas C-47 *On order:* 4 Lockheed L-1049G Super Constellation 3 Boeing 707-437	18,886	—	89,549	1,464,000	3,410,500	State-owned.
Indian Airlines Corporation	Thapar House, Janpath, New Delhi Chairman: Shankar Prasad Gen. Manager: Air Commodore P. C. Lal Chief Traffic Manager: J. M. Gupta	6 Douglas DC-4 63 Douglas DC-3 12 Vickers Viking 8 D.H. Heron *On order:* 10 Vickers Viscount 768	22,700	170,342,790 *284,831,400*	528,764 *64,790*	11,619,243 *28,118*	82,304,628 *13,454,267*	State-owned. Operates Indian domestic services.
Kalinga Airways (Private) Ltd.	—	15 Douglas DC-3	—	—	—	—	—	Formed in 1958 by merging of four leading independent companies—Kalinga, Indamer, Jawair and Darbhanga—to concentrate at first on non-scheduled operations, charter, etc.
INDO-CHINA								
Air Laos	4 Rue Pierre Morin, Vientiane	Boeing B.307 Stratoliners Douglas DC-3's Bristol Freighters	—	—	—	—	—	Formed in 1952 by Air France (30%), Aigle Azur (20%) and local interests. Operates internally and to Saigon. Bangkok and Hong Kong.
INDONESIA								
Garuda Indonesian Airways N.V.	Djalan Nusantara 15, Djakarta President: Dr. M. Soetoto Executive Vice-Presidents: Dr. R. Sugoto Dr. C. A. Mochtar	8 Convair 240 8 Convair 340 20 Douglas DC-3 *On order:* 3 Convair 440 3 Lockheed Electra	—	8,990,447 *483,021*	463,497 *6,111*	6,276,751 *7,963*	20,646,597 *65,621*	State-owned from March, 1954.
IRAN								
Iranian Airways Company (IRANAIR)	Teheran International Airport, Teheran Man. Director: Reza Afshar Gen. Manager: Sherwood Nichols Director of Ops.: Joseph Morris	2 Convair 240 2 Douglas DC-4 6 Douglas DC-3 2 D.H. Dove 4 D.H. Rapide *On order:* 3 Vickers Viscount	11,173	1,664,653 *1,216,040*	68,737 *50,389*	227,076	1,532,972 *264,314*	Under 5-year management contract with Transocean Air Lines, Oakland, California.
Persian Air Services (P.A.S.)	Ferdowski Avenue 486, Teheran A. Chafik J. P. Lee Warner	2 Avro York	10,800	—	—	—	—	—
IRAQ								
Iraqi Airways	International Railway Station Building, Baghdad West Gen. Manager: Kanaan Al Askari	3 Vickers Viscount 735 3 Vickers Viking 1 D.H. Dove *On order:* 1 Vickers Viscount 773	9,954	1,479,886 *182,058*	79,242 *3,291*	139,656	910,444	State-owned.
IRELAND								
Aer Lingus Teoranta	43, Upper O'Connell Street, Dublin Chairman: P. Lynch Gen. Manager: J. F. Dempsey	1 Vickers Viscount 808 4 Vickers Viscount 707 10 Douglas DC-3 *On order:* 5 Vickers Viscount 808 7 Fokker Friendship	5,656	3,859,209 *305,157*	420,560 *10,687*	3,602,625 *1,951*	9,461,305 *2,851,251*	Aer Rianta has 95.4% interest on behalf of Irish Government. B.E.A. holds remaining 4.6%.

Non-scheduled traffic figures in italic type.

Airline	Head Office and Management	Fleet	Route Mileage	Miles Flown 1957	Passengers 1957	Mail (lb.) 1957	Freight (lb.) 1957	Remarks
ISRAEL								
El Al Israel Airlines Ltd.	76 Maze Street, Tel-Aviv Man. Director: General E. Ben-Arzi	3 Bristol Britannia 313 4 Lockheed L-049 Constellation *On order:* 1 Bristol Britannia	28,610	2, 98,249 *233,066*	43,600 *5,294*	421,109	1,460,594	State owns 63% and Public Institutions 37%. Has 50% interest in "Arkia."
Israel Inland Airlines Ltd. (ARKIA)	42 Maze Street, Tel-Aviv Man. Director: J. Hozman Tech. Manager: L. Bigon	4 Douglas DC-3 1 Beechcraft D-18S *On order:* 1 Beechcraft D-18S	186	475,416	65,977	4,550	149,275	—
ITALY								
Alitalia-Linee Aeree Italiane	82-94 Viale Pilsudsky, Rome Chairman: Count Dr. Nicoló Carandini Gen. Manager: Ing. Bruno Velani	4 Douglas DC-7C 11 Douglas DC-6 and DC-6B 2 Convair 440 4 Convair 340 10 Vickers Viscount 785 12 Douglas DC-3 *On order:* 6 Douglas DC-8	—	—	221,639	4,848,000	11,237,000	Formed by the merger of Alitalia and LAI.
JAPAN								
All-Nippon Airways Co., Ltd. (ANA)	—	9 Douglas DC-3 3 D.H. Heron 4 D.H. Dove 1 Piper Tri-Pacer 1 Auster Autocar 6 Bell 47 2 Handley Page Marathon	4,705	—	—	—	—	Merger of Japan Helicopters Aircraft Transport (JHAT) and Far Eastern Airlines (FEAL). Merger effective February 10, 1958. Began consolidated operations under ANA flag on December 1, 1957. Serves 20 cities all over Japan.
Far Eastern Airlines Co., Ltd.	Osaka Building, No. 1, Soze-cho, Kita-Ku, Osaka President: W. Kanno Gen. Manager: Adl. T. Nakamura	3 Auster J5G Autocar 2 D.H. Dove 2 Handley Page Marathon 2 Douglas DC-3C	—	—	—	—	—	Merged with Japan Helicopter Aircraft Transport to form All-Nippon Airways February 10, 1958.
Japan Air Lines Company Ltd.	Tokyo Building, 2-chome, Marunouchi, Chiyodaku, Tokyo President: S. Yanagita Vice-President: S. Matsuo	1 Douglas DC-7C 6 Douglas DC-6B 8 Douglas DC-4 *On order:* 3 Douglas DC-7C 4 Douglas DC-8	12,294	7,886,176 *84,809*	422,557 *430*	2,719,401 *19,240*	5,211,056 *38,873*	—
JORDAN								
Air Jordan Co., Ltd.	P.O. Box 274, Amman Exec. Director: R. M. Stanley	4 Douglas DC-3 1 Curtiss C-46F	2,559	617,096	20,760	3,338	35,779	—
Arab Airways (Jerusalem) Ltd.	King Hussein Street, Amman Manager: Wadi Salameh	3 Douglas DC-3	9,242	775,793 *94,984*	25,827 *1,133*	23,490	273,09 9 *38,076*	The National Airline of Jordan in association with B.O.A.C.
KOREA (North)								
Ukamps	Prospekt Stalina, Pyongyang, Korean Democratic Republic	Li-2	—	—	—	—	—	Successor to Soviet-Korean airline Sokao. Operates between Pyongyang and Mukden and Chita.
KOREA (South)								
Korean National Airlines	No. 1 First Street, Chyong-No District, Seoul President Y. W. Shinn Ops. Director: J. H. Taylor	3 Douglas DC-3 2 Douglas DC-4	—	—	—	—	—	State-owned.
KUWAIT								
Kuwait Airways Ltd.	P.O. Box 394, Kuwait Chairman: A. S. Alkhalid Manager: A. R. Mishri	2 Douglas DC-4 2 Douglas DC-3	—	—	—	—	—	Founded in 1953, originally as Kuwait National Airways. An associate of B.O.A.C.
LEBANON								
Air Liban	Riad Solh Square-Esseily Building, P.O. Box 1243, Beirut Director General: Henry Naccache	2 Douglas DC-6C 2 Douglas DC-4 3 Douglas DC-3 1 S.E. 161 Languedoc *On order:* 1 Douglas DC-6C	13,248	1,933,339 *51,642*	57,433 *3,120*	115,129 *836*	3,035,120 *48,491*	Air France has 38% interest.

Non-scheduled traffic figures in italic type.

Airline	Head Office and Management	Fleet	Route Mileage	Miles Flown 1957	Passengers 1957	Mail (lb.) 1957	Freight (lb.) 1957	Remarks
LEBANON—*cont.*								
Lebanese International Airways	Beirut President: A. Arida	2 Lockheed L-1049 Super Constellation	—	—	—	—	—	Seaboard & Western Airlines have 30% ownership and have supplied aircraft. Two additional Super Constellations will be added later for service expansion.
Middle East Airlines, Co. S.A. (MEA)	Maktabi Building, Abdul Aziz Street, Beirut Chairman and Man. Director: Sheikh Najib Alamuddin Gen. Manager (Ops.): Capt. R. Hornall	6 Vickers Viscount 754 4 Douglas DC-3 3 Avro York 1 Bristol 170 Wayfarer *On order:* 1 Vickers Viscount 754	35,659	2,919,558 *732,121*	79,267 *11,863*	236,174 *1,903*	1,630,905 *2,140,188*	—
Trans-Mediterranean Airways	Rue Maamary, P.O. Box 3018, Beirut Man. Director: Munir Abu Haidar Gen. Manager: M. V. Richmond	7 Avro York	23,011	1,126,112 *710,476*	— *6,479*	—	6,778,200 *10,137,600*	Freighting contracts with Iraq Petroleum Co. and Aramco.
LIBERIA								
Liberian National Airways (L.N.A.)	Roberts Field, Liberia, West Africa Gen. Manager: Frederick H. Syphert	2 Douglas DC-3	1,932	—	—	—	—	Government-owned
MADAGASCAR								
Air Madagascar	8 Rue Général Roques, Tananarive Chairman: Général Fayet Gen. Manager: M. Vernier	2 Douglas DC-3 5 D.H. 89 1 Cessna 170 *On order:* 1 Douglas DC-3 3 Max Holste Super Broussard 1 Max Holste Broussard	5,084	636,837 *151,633*	18,050	217,605	4,958,644	—
MALAYA								
Federation Air Service (Malaya) (F.A.S.)	Malayan Railways, Kuala Lumpur Chairman and Deputy Manager: D. D. Bartlett	6 D.H. Beaver	692	—	—	—	—	Taken over by Malayan Airways Ltd. on March, 1, 1958.
Malayan Airways Ltd.	Airways House, 26 Raffles Place, Singapore, 1 Man. Director: J. A. Vick Gen. Manager: Capt. J. W. Solly Chief Pilot and Ops. Manager: Capt. D. W. Fenton	11 Douglas DC-3 3 D.H. 89 Rapide	55,057	2,758 *213,373*	129,328 *1,128*	1,373,540 total	7,328,388 *2,170,563*	Took over Federation Air Service on March 1, 1958.
MALTA								
The Malta Airlines	60 South Street, Valletta Chairman: Lt. Col. R. G. Strickland Gen. Manager: J. T. Crossey	—	—	—	—	—	—	Incorporates Malta Airways Co., Ltd. and Air Malta Co., Ltd. Services operated by B.E.A.
MEXICO								
Aerolineas Mexicanas, S.A.	Boulevard Aeropuerto Central 161, Mexico, D.F. Gen. Manager: Lic Rubén Ruiz Alcántara	3 Douglas DC-3 *On order:* 2 Douglas DC-4	2,597	511,120	25,363	37,936	686,818	Has taken over Aerovias Reforma S.A.
Aeronaves de Mexico S.A.	Mariano Escobedo, 543, Mexico, D.F. President: Antonio Díaz Lombardo Gen. Manager: Carlos Ramos	2 Bristol Britannia 302 4 Convair 340 3 Lockheed L-749 Constellation 2 Douglas DC-4 9 Douglas DC-3 2 Douglas C-47 *On order:* 1 Bristol Britannia 2 Lockheed Electra	7,552	6,756,718 *719,690*	426,549 total	599,660	8,100,000 total	Pan American World Airways have 13.65% interest.
Aero-Transportes S.A. (A.T.S.A.)	Ave. Juarez No. 117-A, Mexico, D.F. President: R. O'Farrill Gen. Manager: H. J. Filshinger	Douglas DC-3's	192	—	—	—	—	Operates in conjunction with Compañiá Mexicana de Aviación S.A. from which aircraft are leased. Combines the resources of Aerovias Latino-Americanos S.A., Aerovias Transcontinentales S.A. and Transportes Aereos de Jalsico S.A.

Non-scheduled traffic figures in italic type.

Airline	Head Office and Management	Fleet	Route Mileage	Miles Flown 1957	Passengers 1957	Mail (lb.) 1957	Freight (lb.) 1957	Remarks
MEXICO—*cont.*								
Cia. Mexicana de Aviacion, S.A. (Mexicana)	Balderas 36, Mexico City	3 Douglas DC-7C 4 Douglas DC-6 6 Douglas DC-4 15 Douglas DC-3 4 Douglas C-47 (freight) 4 Fairchild C-82 (freight)	—	13,195,933 1,836,711	—	1,715,293 total	37,902,760 total	Pan American World Airways have a 41.86% interest.
Guest Aerovias Mexico, S.A.	Reforma 95, Mexico City President: Winston Guest Vice-President and Gen. Manager: G. L. Monteiro Ops. Manager: R. H. Walroth	2 Lockheed L-749A Constellation 1 Douglas DC-4 2 Fairchild C-82	4,770	1,458,926 *78,162*	37,711 *1,325*	113,584	902,260	—
Trans Mar de Cortes S.A.	Esquerro Num. 30, La Paz, Baja California Man. Director: Mayo Obregon Tapia Gen. Manager: Luis Coppola B.	3 Douglas DC-3C *On order:* 1 Fairchild F-27	5,237	672,908 *202,154*	25,687 *4,577*	622,300 *4,885*	962,257 *32,117*	—
Transportes Aereos Mexicanos S.A. (T.A.M.S.A.)	Calle 6 No. 518, Mérida, Yacatán President: Arturo P. G. Canton Gen. Manager: J. V. Hernández	1 Douglas DC-3 1 Douglas C-47 1 Consolidated Vultee B-24J 3 Fairchild C-82A	1,029	—	—	—	—	—
MOROCCO								
Compagnie Nationale de Transports Aeriens Royale Air Maroc	65 Avenue de l'Armée Royale, Casablanca Director Général: A. Faurons	1 Lockheed Constellation 4 Douglas DC-4 3 Douglas DC-3 *On order:* 3 Sud Caravelle	27,360	—	—	—	—	Formerly known as Compagnie Chérifienne de Transports Aériens "Air Atlas/Air Maroc" and owned equally by Air France, the Moroccan Government and the Paquet and Fraissinet Shipping Group.
NEPAL								
Royal Nepal Airlines Corporation	Katmandu	—	—	—	—	—	—	Formed by Nepalese Government, which holds 51% interest, to take over all internal air services operated by associates of Indian Airlines Corpn. Began operations on July 1, 1958, with one DC-3 leased from Indian Airlines Corpn. Ultimately 4 DC-3's will be used.
NETHERLANDS								
Koninklijke Luchtvaart Maatschappij N.V. (K.L.M. Royal Dutch Airlines)	Plesmanweg 1, The Hague President: I. A. Aler Deputy President: M. J. van der Ploeg	14 Convair 340 2 Convair 240 10 Douglas DC-7C 8 Douglas DC-6A/B 6 Douglas DC-6 5 Douglas DC-4/C-54 14 Douglas DC-3/C-47 (3 chartered to De Kroonduif) 9 Vickers Viscount 803 *On order:* 2 Douglas DC-7C 3 Lockheed L-1049H Super Constellation 8 Douglas DC-8 12 Lockheed Electra	171,000	41,895,000 *1,555,000*	889,700 *23,100*	6,426,000 *3,000*	54,377,000 *671,300*	State holds approx. 68% interest.
NETHERLANDS ANTILLES								
Koninklijke Luchtvaart Maatschappij N.V. (K.L.M. Royal Dutch Airlines, Caribbean Division)	Curaçao, Netherlands Antilles Gen. Manager: C. C. Steensma	4 Convair 340 4 Douglas DC-3	7,570	—	—	—	—	—
NETHERLANDS NEW GUINEA								
Nederlands Nieuw Guinea Luchtvaartmaatschappij "De Kroonduif" N.V.	Plesmanweg 1, The Hague, Netherlands Management conducted by K.L.M.	3 Douglas DC-3 2 Scottish Aviation Twin Pioneer 3 D.H. Beaver	2,000	353,900 *42,900*	17,100 *1,300*	171,600 *1,200*	633,200 *199,700*	Managed by K.L.M. from which DC-3's are chartered.

Non-scheduled traffic figures in italic type.

Airline	Head Office and Management	Fleet	Route Mileage	Miles Flown 1957	Passengers 1957	Mail (lb.) 1957	Freight (lb.) 1957	Remarks
NEW CALEDONIA								
Société Calédonienne de Transports Aériens (TRANSPAC)	Rue du Général Galliéni, Noumea President: G. Martinet Manager: H. C. Coursin	3 D.H. 89 *On order:* 1 D.H. Heron	790	154,572 *429*	7,370 *57*	17,170	157,185	—
NEW GUINEA								
Gibbes Sepik Airways Ltd.	Goroka Man. Director: R. H. Gibbes Gen. Manager: V. W. Cox	3 Junkers Ju 52/3 6 Noorduyn Norseman	1,440	57,100 *403,000*	1,825 *14,945*	37,552 *91,611*	994,581 *7,015,843*	—
Mandated Airlines Ltd.	Lae Man. Director: J. B. Sedgers Manager: H. J. Hindwood	5 Douglas DC-3 3 D.H. 84 Dragon	2,654	749,725 total	34,569 total	87,581 total	9,204,390 total	—
NEW ZEALAND								
New Zealand National Airways Corporation (N.Z.N.A.C.)	P.O. Box 96, Aotea Quay, Wellington Chairman: Sir Leonard Isitt, K.B.E. Gen. Manager: Capt. J. J. Busch, O.B.E. Ops. Manager: P. Mathison	22 Douglas DC-3 4 Douglas DC-3 (Freighter) 2 D.H. 89 1 Vickers Viscount 807 *On order:* 2 Vickers Viscount 807	3,679	6,958,044	473,783 *4,749*	248,177 ton-miles	20,138,520 *4,337,517*	—
Tasman Empire Airways Ltd. (TEAL)	Airways House, Customs Street, Auckland Chairman: Sir Leonard M. Isitt, K.B.E. Gen. Manager: G. N. Roberts	3 Douglas DC-6 1 Short Solent 4 *On order:* 3 Lockheed Electra	10,000	2,035,424 *140,250*	65,140 *92*	1,165,447 *13,062*	906,957	Jointly owned by Governments of New Zealand (50%) and Australia (50%).
Trans-Island Airways, Ltd.	Christchurch International Airport Chairman: G. L. McLatchie Gen. Manager: Capt. B. G. Chadwick	1 Beechcraft D-18S 1 Lockheed 10A 2 D.H. 89	1,500	—	—	—	—	Formed in 1956 for domestic services in New Zealand and for services to Rongotai and Chatham Islands.
West Coast Airways, Ltd.	Seaview Airport, Hokitika, Westland	2 D.H. 89A Dragon Rapide	—	—	—	—	—	Took over scheduled services between Hokitika, Haast and Milford Sound from N.Z. N.A.C. in 1956.
NICARAGUA								
Lineas Aereas de Nicaragua, S.A. (LANICA)	P.O. Box 428, Managua President: Gen. Anastacio Somoza Vice-President and Treasurer: Col. Camilo Gonzalez G.	6 Douglas C-47 2 Curtiss C-46 1 Beechcraft C-45 *On order:* 2 Vickers Viscount 786	1,857	—	—	—	—	Pan American World Airways holds a 40% interest. Nicaraguan Government has a 10% interest.
NORWAY								
Braathen's South American and Far East Airtransport A/S (S.A.F.E.)	Fr. Nansenspl. 7, Oslo President: Ludv. G. Braathen Vice-President: Bjorn G. Braathen Ops. Manager: J. Road	2 Douglas DC-4 2 Douglas DC-3 2 D.H. Heron *On order:* 3 Fokker Friendship	916	863,827 *14,646*	53,105 *201*	303,631	365,784	Two Douglas DC-4 on charter to Icelandic Airlines (Loftleidir), Reykjavik.
Det Norske Luftfartselskap A/S (D.N.L.)	Oslo Chairman: Per M. Hansson President: O. Steen	—	—	—	—	—	—	A non-operating holding company in the SAS Consortium. See under "Scandinavia."
Vestlandske Luftfartselskap A/S (West Norway Airlines)	Bergen President: J. Horn Director: S. Liby	1 D.H. Heron 2 Short Sealand 1 Republic Seabee	—	—	—	—	—	In liquidation.
Wideroe's Flyveselskap A/S	Kr. Augustsgt. 19, Oslo Gen. Manager: Viggo Widerö	4 D.H. Otter 6 Noorduyn Norseman 4 other aircraft	2,137	351,080 *235,030*	15,964 *1,939*	68,792	16,042	—
PAKISTAN								
Pakistan International Airlines	PIA Administration Building, Karachi Airport. Gen. Manager: Zafarul Ahsan, C.S.P. Flight/Ops. Manager: Capt. Shaukat Khan	3 Lockheed L-1049C Super Constellation 4 Convair 240 10 Douglas DC-3 *On order:* 2 Lockheed L-1049H Super Constellation 3 Vickers Viscount 815	12,843	4,390,020 *443,523*	190,592 *10,321*	1,517,833 *4,928*	4,796,404 *3,911,401*	State-owned.

Non-scheduled traffic figures in italic type.

Airline	Head Office and Management	Fleet	Route Mileage	Miles Flown 1957	Passengers 1957	Mail (lb.) 1957	Freight (lb.) 1957	Remarks
PANAMA								
Aerovias Panama	The Warwick, 65 West 54th Street, New York, U.S.A.	—	—	—	—	—	—	Operates between Panama City, Kingston, Jamaica, and Miami with aircraft and crews supplied by Trans-Caribbean Airways.
Compania Panamena de Aviacion S.A. (C.O.P.A.)	Avenida Peru 25, Panama, R.P. President: Ricardo Arias, Jr.	6 Douglas DC-3	542	—	—	—	—	Pan American World Airways has a 33% interest.
PERU								
Campañia de Aviacion Faucett S.A.	Jirón Unión 926, Hotel Bolivar, Lima President: E. Dibós D. Man. Director: A. Bentín M.	4 Douglas DC-4 8 Douglas DC-3 4 Faucett-Stinson	5,267	3,107,773	158,467	1,204,400	29,792,307	—
PHILIPPINES								
Philippine Air Lines, Inc.	M.R.S. Building, Plaza Cervantes, Manila President: Andres Soriano First Vice-President: A. M. Macleod	24 Douglas DC-3 2 Vickers Viscount 784 1 Convair 340 4 DHC-3 Otter 2 Hiller UH-12B *On order:* 5 Scottish Aviation Twin Pioneer 2 Fokker Friendship	—	5,626,215 *768,788*	430,101 *18,654*	986,878 *32,047*	15,054,730 *1,556,096*	Pan American acquired 20% interest in 1957.
POLAND								
Polskie Linie Lotnicze (LOT)	ul. Hoza 39, Warsaw Director-General: A. Skala Director-Technical: W. Leja Director-Commercial: A. Wojnowski	54 aircraft of following types: Convair 240 Ilyushin I1-14 Ilyushin I1-12 Li-2 Douglas C-47	6,520	4,219,480	223,388 *880*	1,541,321	3,202,709 *77,501*	Activities include scheduled air services, charter flights, crop and forest dusting and other work.
PORTUGAL								
Transportes Aéreos Portugueses, S.A.R.L. (T.A.P.)	Rue Braamcamp No. 2, Lisbon Chairman Brigadier João de Freitas Ops. Superintendent: Comdr. Roger de Avelar	6 Douglas DC-3 3 Douglas DC-4 3 Lockheed L-1049G Super Constellation	17,576	1,984,967 *35,888*	47,087	525,345 ton-miles	427,085 ton-miles	Formerly state-owned. Became a private company June 1, 1953.
PORTUGUESE AZORES								
Sociedade Açoriana de Transportes Aéreos, Ltda. (SATA)	7-11, Rua dos Mercadores, Ponta Delgada, S. Miguel Gen. Manager: A. M. S. Noqueira	2 D.H. Dove	423	—	—	—	—	Operates inter-island services.
PORTUGESE EAST AFRICA								
Divisão de Exploração dos Tranportes Aéreos (DETA)	103 Rua Araújo, P.O. Box 276, Lourenço Marques Director General: A. H. Brazão de Freitas Acting Gen. Manager: Abel Neves de Azevedo	3 Douglas DC-3 3 Lockheed Lodestar 4 D.H. Dove 2 Junkers Ju52/3m 1 D.H. 90 Dragonfly 2 D.H. 87 Hornet Moth *On order:* 1 Douglas DC-3 2 Fokker F-27 Friendship	2,938	1,342,148 *95,840*	24,280 *568*	205,973	563,186	Organised by Colonial Government of Mozambique in 1936 as Division of the Dept. of Railways, Harbours and Airways.
PORTUGUESE INDIA								
Transportes Aéreos da India Portuguesa (TAIP)	Mormugão, Goa Director: Lt. Col. Solano d'Almeida	2 Vickers Viking *On order:* 2 Douglas DC-4 1 D.H. Heron	2,827	228,951 *87,036*	3,620	60,096	33,534	Links Portuguese enclaves in India with Karachi, Aden and Lourenço Marques.
PORTUGUESE TIMOR								
Transportes Aéreos de Timor (T.A.T.)	Dili Airport, Timor Manager: F. L. V. A. Cardosa Dias	2 D.H. Dove	560	—	—	—	—	State-owned.
PORTUGUESE WEST AFRICA								
Divisão de Exploração dos Transportes Aéreos (D.T.A.)	Rua Pereira Forjaz, P.O. Box. 79, Luanda, Angola President: Eng. Pereira Leite Man. Director: Lt. Col. J. de Silva Medina	6 Douglas DC-3 5 Beechcraft D-18S 3 D.H. Dragon Rapide *On order:* 2 Douglas DC-3	5,362	1,157,861 *71,483*	33,543 *729*	364,615	991,774 *8,023*	Formed in 1938 as Division of the Ports, Railways and Transport Administration.

Non-scheduled traffic figures in italic type.

Airline	Head Office and Management	Fleet	Route Mileage	Miles Flown 1957	Passengers 1957	Mail (lb.) 1957	Freight (lb.) 1957	Remarks
PORT. WEST AFRICA—*cont.*								
Serviço de Transportes Aéreos (STA)	Aeroporto, S. Tomé Gen. Manager: Vicente Cebolas Cortes	1 D.H. Tiger Moth 1 Piper Super Cruiser 1 Auster Autocar 3 D.H. 89A Dragon Rapide *On order* 1 D.H. 89A Dragon Rapide	268	34,275 *5,139*	883 *205*	2,238 *212*	11,541 *4,262*	—
PUERTO RICO								
Caribbean Atlantic Airlines, Inc. (CARIBAIR)	San Juan President: Dionisio Trigo Vice-President: Benigno Trigo	5 Douglas DC-3	462	1,042,879 *22,954*	224,264 *2,601*	546,000	1,011,600 *70,000*	—
RUMANIA								
Transporturi Aeriene Romine (TAROM)	Aeroportul Baneasa, Bucharest Manager: Ing, Stingaciu Vladimir Asst. Manager: Vaduva Gheorghe	Ilyushin I1-14's Ilyushin I1-12's Li-2's	5,000 Approx.	—	—	—	—	State-owned.
SAUDI ARABIA								
Saudi Arabian Airlines	Jedda Tech. Manager: R. W. Wilson Asst. Tech. Manager: Geo. C. Harrington	10 Convair 340 4 Douglas DC-4 10 Douglas DC-3 5 Bristol Wayfarer	4,500 Approx.	—	—	—	—	Government-owned. Managed by T.W.A. Traffic kept by Government and not published.
SCANDINAVIA								
Scandinavian Airlines System (SAS)	Bromma Airport, Stockholm 40 President: Henning Throne-Holst Exec. Vice-President: Sven Östling	14 Douglas DC-7C 13 Douglas DC-6B 12 Douglas DC-6 16 Convair 440 2 Saab Scandia 4 Douglas DC-3 *On order:* 7 Douglas DC-8 12 Sud Caravelle 4 Convair 440	119,817	34,852,040 *431,666*	1,450,344 *12,625*	11,987,566	25,512,610	A consortium consisting of the national airlines of Denmark (DDL), Norway (DNL) and Sweden (ABA).
SOUTH AFRICA								
Commercial Air Services (Pty.) Ltd. (Comair)	Seventh Floor, Balgownie House, Commissioner Street, Johannesburg Directors: J. M. S. Martin M. Geffen L. Zimmerman M. D. N. Wyatt A. C. Joubert T. V. Mitchell	3 Lockheed Lodestar Cessna 170's, 172's 180's and 182's	450	—	—	—	—	Associated Company of Airwork Ltd., London
South African Airways (S.A.A.)	Jan Smuts Airport, Kempton Park, Transvaal Chief Airways Manager: Col. J. D. T. Louw	3 Douglas DC-7B 4 Lockheed Constellation 7 Douglas DC-4 6 Douglas DC-3 *On order:* 1 Douglas DC-7B 7 Vickers Viscount 813 3 Boeing 707-320	42,828	7,660,009 *243,662*	302,102 *2,981*	3,369,550 *200*	4,341,570 *10,342*	State-owned.
SOUTH WEST AFRICA								
South West Air Transport (Pty.) Ltd.	The Airport, Windhoek Chairman: P. H. M. Du Plessis Manager: G. T. van Rooyen	6 Ryan Navion 1 D.H. Rapide	—	—	—	—	—	Operates feeder services to connect with S.A.A. flights at Windhoek.
SOVIET UNION								
Aeroflot-Grazdanskij Wozdusnyj Flot (Aeroflot)	Hotel Metropol, Sverdlov Square, Moscow Dir. General: Marshal P. F. Zhigarev Deputy Dir. General: Lt. Gen. N. A. Zakharov	Tu-104's Il-14's Il-12's Li-2's An-2's, etc. *On order:* Tu-114's Tu-110's Il-18's An-10's, etc.	230,000 Approx.	—	4,000,000 Approx.	—	—	Total fleet strength is said to be more than 400 aircraft.
SPAIN								
Aviacion y Comercio, S.A. (AVIACO)	Aduana, 33-3°-Madrid President and Director General: José Pazó Montes	8 S.E. 161 Languedoc 4 Bristol 170 8 D.H. Heron	9,123	2,477,866 *85,050*	25,155 *6,041*	2,114,231 *1,094*	4,005,795 *15,644*	—
Lineas Aereas de España S.A. (IBERIA)	Avenida de America, 2, Madrid President: Tomás Delgado Gen. Manager: César G. Lucía Ops. Supt. José Ansaldo	5 Lockheed L-1049G Super Constellation 5 Convair 440 6 Douglas DC-4 16 Douglas DC-3 4 Bristol 170 Freighter	49,792	10,952,602	738,272	2,392,652	4,513,426	—

Non-scheduled traffic figures in italic type.

Airline	Head Office and Management	Fleet	Route Mileage	Miles Flown 1957	Passengers 1957	Mail (lb.) 1957	Freight (lb.) 1957	Remarks
SUDAN								
Sudan Airways	Gaon Buildings, P.O. Box 253, Gamhouria Avenue, Khartoum Gen. Manager: Abdel Bagi Mohaned Ops. Manager: D. W. Graham	4 D.H. Dove 4 Douglas DC-3 *On order:* 2 Douglas DC-3	6,091	1,151,259 *222,126*	24,081 *4,837*	125,976 *3,852*	1,128,159 *42,856*	A department of the Sudan Government. Statistics for 12 months ending June 30, 1957.
SWEDEN								
Aero-Nord Sweden A.B.	Bromma Airport, Stockholm 40 Man. Director: P. S. Holmström	1 Aero Commander 2 Piper Cub 1 Airspeed Oxford *On order:* 1 Aero Commander 2 Piper Cub	—	—	—	—	—	Operates scheduled newspaper and passenger services.
Aktiebolaget Aerotransport (A.B.A.)	Bromma Airport Stockholm 40 Chairman: Axel Gjöres President: Sture Blomberg	—	—	—	—	—	—	A non-operating company in the SAS consortium. See under "Scandinavia".
Linjeflyg A.B.	c/o Dagens Nyheter, Tegelbacken, Stockholm	4 Douglas DC-3 4 Lockheed Lodestar *On order:* 1 Douglas DC-3	—	—	—	—	—	Aircraft are owned by Airtaco A.B.
Ostermans Aero A.B.	Stockholm President: N. Billing	2 Sikorsky S-55 13 Bell 47 2 Republic Seabee *On order:* 1 Bell 47J	—	— *260,980*	—	154,325	—	Operates scheduled winter mail service throughout Stockholm Archipelago and year-round non-scheduled flights.
Transair Sweden AB	Bromma Airport, Stockholm 40 President: P. Loven Ops. Manager: Count C. G. v. Rosen	4 aircraft *On order:* 1 aircraft	—	— *977,843*	— *23,008*	—	— *1,032,100*	—
SWITZERLAND								
Swiss Air Transport Company Limited (Swissair)	Hirschengraben 84, Zurich President: Dr. Walter Berchtold	4 Douglas DC-7C 6 Douglas DC-6B 3 Douglas DC-4 8 Douglas DC-3 11 Convair 440 *On order:* 3 Douglas DC-8 1 Douglas DC-7C 1 Douglas DC-6A	71,741	17,893,067 *209,567*	985,216 *7,695*	9,591,049 *5,357*	26,899,607 *377,323*	State holds 30% interest. Swissair Photo Ltd. is a wholly-owned subsidiary.
SYRIA								
Syrian Airways Company	P.O. Box 417, Damascus Gen. Manager: N. Baker	Douglas DC-4's Douglas DC 3's	—	—	—	—	—	—
TAHITI								
Régie Aérienne Interinsulaire	Messageries Maritimes, Quai Bir Hakeim, Papeete	2 Consolidated PBY Catalina	—	—	—	—	—	Operates from Tahiti to other islands in the Society Group.
TAIWAN (FORMOSA)								
Civil Air Transport (C.A.T.)	46, Chung Shan Road, North 2nd Section, Taipei	3 Douglas DC-4 25 Curtiss C-46 5 Douglas DC-3 2 Convair Catalina *On order:* 2 Douglas DC-6B	6,762	—	—	—	—	—
Foshing Airlines	30, Shinn Yang Street, Taipei Chairman: Moon F. Chin President: Ango Tai	1 Convair Catalina 1 Curtiss C-46 2 Douglas DC-3	536	—	—	—	—	—
THAILAND								
Thai Airways Co Ltd.	6 Larn Luang Road, Bangkok Chairman: Air Marshal Chalermkiat Vatanangura Man. Director: Lieutentant Commander Prasong Sushiva	3 Lockheed L-1049G 3 Douglas DC-4 4 Douglas DC-3 1 Noorduyn Norseman 1 Beechcraft Bonanza	7,653	2,717,229 *83,866*	95,053 *3,654*	828,173 *3,673*	2,233,935 *47,329*	Government hold 95% of capital.
TUNISIA								
Société Tunisienne de l'Air (Tunis Air)	1 Rue d'Athènes, Tunis Gen. Manager: P. F. Delaunay	2 Douglas DC-4 3 Douglas DC-3	6,404	1,309,888	111,400	477,624	1,516,832	Tunisian Government and Air France respectively hold 51% and 49% of capital.

Non-scheduled traffic figures in italic type.

Airline	Head Office and Management	Fleet	Route Mileage	Miles Flown 1957	Passengers 1957	Mail (lb.) 1957	Freight (lb.) 1957	Remarks
TURKEY								
Türk Hava Yollari Anonim Ortakligi (Turkish Airlines Inc.) (THY)	Cankiri Caddesi No. 88, Ankara General Manager: General Enver Akoglu Ops. Manager: Suphi Isçen	7 D.H. Heron 19 Douglas DC-3 2 Douglas DC-3 (Freighter) *On order:* 5 Vickers Viscount 794	7,468	4,241,559 *202,009*	322,104 *7,776*	458,150 *2,203*	3,889,867 *244,493*	—
URUGUAY								
Compânia Aeronautica Uruguaya S.A. (Causa)	Calle Colonia 1068, Montevideo President: J. Americo Beisso Man. Director: Col. Tydeo L. Borges	3 Short Sandringham	154	—	—	—	—	—
Primeras Lineas Uruguayas de Navegación Aérea (PLUNA)	Colonia y Avda Agraciada, Montevideo President: Coronel Eusebio B. Vaeza Gen. Manager: Ing. Roberto Langon Balparda	6 Douglas DC-3 *On order:* 3 Vickers Viscount 769	6,719	1,415,706	91,979	24,502	693,505	Government-owned.
U.S.A.								
Aaxico Airlines, Inc.	Building T-143 Miami International Airport, Miami, Florida President: Howard J. Korth Vice-President: and Gen. Manager: Jean G. Helvey	37 Curtiss C-46 *On order:* 1 Douglas DC-6A	—	733,885 *6,640,541*	—	79,049	5,512,928 *12,386,000*	Formerly known as American Air Export and Import Company. All-cargo operator with scheduled services between New York, New Orleans and Detroit.
Aerovias Sud Americana, Inc. (ASA International Airlines)	St. Petersburg-Clearwater International Airport, St. Petersburg, Florida President and Gen. Manager: Victor V. Carmichael, Jr. Vice-President (Ops.): M. K. Williams	4 Curtiss C-46F *On order:* 1 Douglas DC-4B	2,650	1,848,412 *88,145*	—	—	8,415,587 ton-miles *433,152* ton-miles	Operates a freight service to Central and South America.
Allegheny Airlines Inc.	Hanger 12, Washington National Airport, Washington 1, D.C. President: L. O. Barnes	15 Douglas DC-3 3 (leased) 7 Martin 202		6,389,219 *10,088*	454,717 *1,431*	1,392,308	4,632,823	—
Alpena Flying Service, Inc.	Alpena County Airport, Alpena, Michigan President: Robert C. Welch Secretary: Coral J. Welch	2 Cessna 195 1 Piper Apache	400	—	—	—	—	—
American Airlines Inc.	100 Park Avenue, New York 17, New York President: C. R. Smith Exec. Vice-President (Ops.): O. M. Mosier	56 Douglas DC-7 85 Douglas DC-6/6A/6B 63 Convair 240 2 Douglas DC-4 *On order:* 2 Douglas DC-7 35 Lockheed Electra 30 Boeing 707-123	14,938	5,361,400,000 pass-miles *5,954,000* pass-miles	8,108,000 *7,000*	20,099,000 ton-miles	94,990,000 ton-miles *78,000* ton-miles	American Airlines de Mexico, S.A. is a wholly-owned subsidiary.
Avalon Air Transport, Inc.	Long Beach Municipal Airport, 3365 Lakewood Blvd., Long Beach, California. President: Wilton R. Probert	1 Sikorsky VS-44A 5 Grumman G-21A *On order:* 1 Sikorsky S-43	118	402,000 *128,000*	71,421 *12,200*	377,000	122,000	Operates amphibian services between Long Beach and Avalon, Catalina Island.
Bonanza Air Lines, Inc.	P.O. Box 391, McCarran Field, Las Vegas, Nevada Chairman: L. G. McNeil President: Edmund Converse Vice-President (Ops.): M. W. Reynolds	10 Douglas DC-3 *On order:* 6 Fairchild F-27	2,110	*3,083,644* *81,610*	*147,710* *2,713*	459,849	1,185,419	Total route network authorized at December 31, 1957, was 2,110 miles, although operations were not inaugurated over 475 miles of the network until January 3, 1958.
Braniff Airways, Inc.	P.O. Box 35001, Dallas, Texas Chairman: Fred Jones President: Chas. E. Beard Vice-President (Ops.): R. V. Carleton	7 Douglas DC-7C 9 Douglas DC-6 6 Convair 440 25 Convair 340 23 Douglas DC-3 2 Lockheed L-049 Constellation 2 Curtiss C-46 *On order:* 9 Lockheed L-188 Electra 5 Boeing 707-227	15,508	36,955,979 *222,039*	2,038,656	13,228,000	28,234,000	—

Non-scheduled traffic figures in italic type.

Airline	Head Office and Management	Fleet	Route Mileage	Miles Flown 1957	Passengers 1957	Mail (lb.) 1957	Freight (lb.) 1957	Remarks
U.S.A.—*cont.*								
Byerly Airlines	Greater Peoria Airport, Peoria, Illinois	Lockheed 10A's and single-engined aircraft		—	—	—	—	Operates service between Jacksonville and Peoria.
Capital Airlines Inc.	Washington 1, D.C. President: J. H. Carmichael Vice-President (Ops.): J. B. Franklin	12 Lockheed 049 Constellation 20 Douglas DC-4 20 Douglas DC-3 59 Vickers Viscount 745 *On order:* 9 Convair 880	7,085	—	—	—		
Catalina Airlines	226 N. Canon Drive, Beverly Hills, California	2 D.H. Dove Douglas DC-3's						Operates scheduled services between Los Angeles and Catalina Island.
Central Airlines, Inc.	Meacham Field, Fort Worth, Texas President: Keith Kahle Vice-President (Ops.): R. L. Wageneck	13 Douglas DC-3		3,319,654 *48,960*	116,987 *1,880*			
Chicago Airways, Inc.	454 Central Avenue, Highland Park, Illinois							Operates local services in Chicago area.
Chicago Helicopter Airways, Inc.	5240 West 63rd Street, Chicago 38, Illinois President: John S. Gleason, Jr. Vice-President (Ops.): R. S. Angstadt	3 Bell 47G 3 Sikorsky S-55 3 Sikorsky S-58C	331	568,171 *29,066*	55,310 *5,466*	2,203,420	—	Operates mail and passenger helicopter services in the Chicago area.
Commodore Aviation	Box 212, Sausalito, California	Trecker Gulls		—				Operates shuttle service between Sausalito and Lake Tahoe.
Continental Air Lines, Inc.	Denver, Colorado President: Robert F. Six Exec. Vice-President: Clarence C. West, Jr. Vice-President (Ops.): O. R. Haueter	4 Douglas DC-7B 4 Douglas DC-6B 1 Douglas DC-6 13 Douglas DC-3 3 Convair 440 6 Convair 340 *On order:* 4 Boeing 707-124 1 Douglas DC-7B 15 Vickers Viscount 812D	6,032	14,994,750	828,659	5,275,860	8,302,000	Merged with Pioneer Air Lines April 1, 1955.
Delta Air Lines, Inc.	Atlanta Airport, Atlanta, Georgia President and Gen. Manager: C. E. Woolman Chairman: R. W. Freeman Vice-President (Ops.): C. H. Dolson	19 Douglas DC-7 and DC-7B 7 Douglas DC-6 13 Douglas DC-3 2 Douglas DC-3 (Freighter) 4 Lockheed Constellation 20 Convair 340 8 Convair 440 5 Curtiss C-46 (Freighter) *On order:* 8 Douglas DC-8 2 Douglas DC-7B 10 Convair 880	10,566	43,521,566 *213,185*	2,712,819 *10,313*	17,307,419	49,314,709 *7,940*	Merged with Chicago and Southern Air Lines on May 1, 1953.
Eastern Air Lines, Inc.	10 Rockefeller Plaza, New York 20, New York Chairman and Gen. Manager: Capt. E. V. Rickenbacker President: T. F. Armstrong	31 Douglas DC-7B 10 Lockheed L-1049G Super Constellation 16 Lockheed L-1049C Super Constellation 12 Lockheed L-1049 Super Constellation 18 Lockheed L-749 Constellation 20 Convair 440 57 Martin 404 1 Douglas C-54 19 leased and operating, but not owned *On order:* 18 Douglas DC-7B 40 Lockheed Electra 20 Douglas DC-8	17,266	135,161,440 total	8,876,283 total	36,280,387 total	59,675,625 total	Absorbed Colonial Airlines, Inc. on June 1, 1956.
The Flying Tiger Line, Inc.	Lockheed Air Terminal, Burbank, California President: Robert W. Prescott Vice-President (Ops.): Frank B. Lynott	12 Lockheed L-1049H Super Constellation 2 Douglas DC-6A	4,853	5,495,565 *10,032,434*	*107,771*	449,470 ton-miles	58,550,639 ton-miles *24,857,566* ton-miles	—
Frontier Airlines, Inc.	Stapleton Airfield Denver 7, Colorado President: C. A. Myhre	15 Douglas DC-3	3,617	5,495,827 *87,859*	213,446 *5,914*	1,396,331	4,883,236	

Non-scheduled traffic figures in italic type.

Airline	Head Office and Management	Fleet	Route Mileage	Miles Flown 1957	Passengers 1957	Mail (lb.) 1957	Freight (lb.) 1957	Remarks
U.S.A.—*cont.*								
Illini Airlines, Inc.	Greater Rockford Airport, Rockford, Illinois President: Douglas G. Harvey	—	—	—	—	—	—	Aircraft maintenance only since September, 1957.
Lake Central Airlines, Inc.	Weir Cook Airport, Indianapolis, Indiana President: G. Hicks Vice-President (Ops.): R. W. Clifford	10 Douglas DC-3	1,745	2,757,983 *23,021*	164,698 *750*	525,580	2,238,140	—
Los Angeles Airways Inc.	5901 West Imperial Highway, Los Angeles 45, California President: C. M. Belinn	5 Sikorsky S-55 2 Sikorsky S-51	333 approx.	570,265 *2,449*	30,035 *1,188*	4,582,067	1,893,350	Operates scheduled passenger, mail and express helicopter services in Los Angeles area.
Mackey Airlines, Inc.	Broward County International Airport, Fort Lauderdale, Florida President: Col. J. C. Mackey Exec. Vice-President: John H. Popham	3 Douglas DC-3 3 Douglas DC-4 *On order:* 2 Fairchild F-27	2,184	818,073 *49,565*	88,147 *1,980*	—	126,000	—
Mohawk Airlines Inc.	Oneida County Airport, Utica, New York Chairman: E. V. Underwood President: R. E. Peach	9 Douglas DC-3 11 Convair 240	1,686	5,170,500 *140,889*	418,431 *7,957*	819,086	4,266,382 total	—
National Airlines, Inc.	Miami International Airport, Miami 48, Florida President and Chairman: G. T. Baker Vice-President (Ops.): L. W. Dymond	4 Douglas DC-7B 4 Douglas DC-7 8 Douglas DC-6B 4 Lockheed L-1049H Super Constellation 4 Douglas DC-6 10 Lockheed Lodestar 12 Convair 340 6 Convair 440 *On order:* 6 Douglas DC-8 23 Lockheed Electra	3,404	25,261,856	1,430,037	9,603,508	20,874,451	—
New York Airways, Inc.	P.O. Box 426, La Guardia Airport Station, Flushing 71, New York President: Robert L. Cummings, Jr. Vice-President: Horace Brock	5 Sikorsky S-55 3 Sikorsky S-58 1 Bell 47H *On order:* 5 Vertol 44B	257	464,333 *14,199*	68,030 *634*	2,550,907	2,198,039	Operates scheduled helicopter services in New York area.
North Central Airlines, Inc.	6201 34th Avenue South, Minneapolis 50, Minn. President: H. N. Carr Vice-President (Ops.): A. D. Niemeyer	27 Douglas DC-3	3,471	9,221,350 *263,027*	680,930 total	2,666,408 *672,178*	4,884,429	—
Northeast Airlines, Inc.	Logan International Airport, Boston, Mass. Chairman of the Board: George E. Gardner President: James W. Austin Vice-President (Ops.): A. A. Lane	11 Douglas DC-3 6 Convair 240 10 Douglas DC-6B *On order:* 9 Vickers Viscount 745D	6,984 (Duplicated)	10,776,864 *20,864*	762,352 *1,265*	517,282 ton-miles	894,074 ton-miles	—
Northwest Airlines, Inc. (Also Northwest Orient Airlines, Inc.)	1885 University Ave., St. Paul 1, Minnesota President: D. W. Nyrop Exec. Vice-President: M. S. Mackay Vice-President (Ops.): F. C. Judd	9 Boeing Stratocruiser 8 Douglas DC-7C 17 Douglas DC-6B 11 Douglas DC-4 5 Douglas DC-3 *On order:* 6 Douglas DC-7C 3 Douglas DC-6B 10 Lockheed Electra	17,445	34,741,738 *72,295*	1,574,035 *1,991*	17,605,791	38,533,192 *31,668*	—
Ozark Air Lines Inc.	P.O. Box 6007, Lambert Field, St. Louis 21, Missouri President: L. Hamilton Ops. Manager: F. E. Myers	20 Douglas DC-3 (3 leased)	3,556	6,118,934 *54,751*	396,164 *3,173*	1,654,690	4,748,828	—

Non-scheduled traffic figures in italic type.

Airline	Head Office and Management	Fleet	Route Mileage	Miles Flown 1957	Passengers 1957	Mail (lb.) 1957	Freight (lb.) 1957	Remarks
U.S.A.—*cont.*								
Pacific Northern Airlines, Inc.	1626 Exchange Building, Seattle 4, Washington President and Gen. Manager: A. G. Woodley Vice-President: J. A. Cunningham	4 Lockheed L-749 Constellation 2 Douglas DC-4 4 Douglas DC-3	4,646	4,081,798 *48,744*	123,848 *2,152*	3,608,000	6,279,950 *90,726*	—
Pacific Southwest Airlines (PSA)	3100 Goddard Way, San Diego California President: K. G. Friedkin Traffic/Sales Manager: Hugh N. Wood	4 Douglas DC-4 *On order:* 3 Lockheed L-188 Electra	451	—	over 260,000	—	—	—
Pan American-Grace Airways, Inc. (Panagra)	135 East 42nd Street, New York 17, New York President: A. B. Shea Vice-President and Gen. Manager: Douglas Campbell Vice-President (Ops.): Thomas J. Kirkland	5 Douglas DC-7B 5 Douglas DC-6B 2 Douglas DC-4 4 Douglas DC-3 *On order:* 4 Douglas DC-8	5,453	5,622,788 *138,213*	136,328 *3,081*	1,160,459 ton-miles *43* ton-miles	4,461,423 ton-miles *71,838* ton-miles	—
Pan American World Airways, Inc.	135 East 42nd Street, New York, 17, New York President: Juan T. Trippe Vice-President (Admin.): John C. Leslie	24 Boeing Stratocruiser 25 Douglas DC-7C 8 Douglas DC-7B (includes 1 leased from Panagra) 45 Douglas DC6B (includes 1 leased to Japan Air Lines, 2 to National Airlines) 3 Douglas DC-6A 4 Douglas DC-6 (leased from Panagra) 26 Douglas DC-4 4 Douglas DC-3 *On order:* 17 Boeing 707-321 6 Boeing 707-121 21 Douglas DC-8	66,428	97,321,229 *4,913,338*	2,784,521 *98,653*	36,511,909 ton-miles *4,025* ton-miles	94,769,336 ton-miles *1,824,768* ton-miles	—
Piedmont Aviation, Inc.	Smith Reynolds Airport, Winston-Salem, N.C. President and Treasurer: T. H. Davis Vice-President H. K. Saunders	21 Douglas DC-3 *On order:* 8 Fairchild F-27	3,173	7,328,821 *95,617*	433,554 *2,774*	1,414,824	2,781,868	—
Provincetown-Boston Airline, Inc.	Municipal Airport, Provincetown, Massachusetts President: John C. Van Arsdale Vice-President: Normand B. Paulhus	1 Lockheed 10A 1 Lockheed 10E 2 Cessna T-50 1 Piper Apache	45	135,000 *76,000*	10,086 *4,253*	3,650	35,000 *4,000*	Operates year-round scheduled service between Boston and Cape Cod, plus considerable contract carrier activity.
Resort Airlines, Inc.	1346 Connecticut Avenue, N.W. Washington 6, D.C. Chairman: Brig. Gen. Thomas B. Wilson President: Harold L. Graham, Jr. Vice-President (Ops.): Douglas P. Larson	8 Douglas DC-4	26,908	— *6,691,818*	— *2,047*	—	— *125,860,000*	Operates scheduled cargo route for United States Air Force.
Riddle Airlines, Inc.	International Airport P.O. Box 535, Miami 48, Florida President: George L. Giles	32 Curtiss C-46 4 Douglas DC-4	24,265	6,669,776 *6,793,677*	—	1,342,976 N/A	57,267,652 *1,225,402*	Operates extensive scheduled all-cargo services, including a large number for the U.S. Armed Services.
Seaboard & Western Airlines, Inc.	80 Broad Street, New York 4, New York President: R. A. Norden Exec. Vice-President: A. V. Norden	2 Lockheed L-1049D Super Constellation 1 Lockheed L-1049E Super Constellation 7 Lockheed L-1049H Super Constellation 3 Douglas DC-4E 2 Curtiss C-46F	6,202	2,324,484 *4,187,864*	— *62,212*	—	6,398,472 *2,410,165*	All-freight operator. Began scheduled transatlantic services in April, 1956.

Non-scheduled traffic figures in italic type.

Airline	Head Office and Management	Fleet	Route Mileage	Miles Flown 1957	Passengers 1957	Mail (lb.) 1957	Freight (lb.) 1957	Remarks
U.S.A.—*cont.*								
Slick Airways, Inc.	3415 Cedar Springs Road, Dallas 19, Texas Chairman and President: D. W. Rentzel	7 Douglas DC-6A 8 Douglas DC-4 13 Curtiss C-46 *On order:* 6 Douglas DC-6A	19,000	—	—	—	—	Scheduled air freight, mail and express carrier. In addition, flies cargo and passengers on charter basis.
Southern Airways, Inc.	114 Brown Marx Building, Birmingham, Alabama President: Frank W. Hulse Vice-President (Ops.) W. S. Magill, Jr.	13 Douglas DC-3	2,015	3,850,069 *50,977*	215,113 *1,502*	1,351,599	1,439,315	Southern Airways, Inc. began Air Freight operations December 1, 1957.
Southwest Airways Company	San Francisco International Airport, California President: J. H. Connelly Exec. Vice-President: T. R. Mitchell	11 Douglas DC-3 7 Martin 202 *On order:* 3 Fairchild F-27	1,896	4,313,468 *238,248*	319,276 *17,924*	1,586,544	1,789,883	Effective March 18, 1958, the company name has been changed from Southwest Airways to Pacific Air Lines.
TAQ Airlines Inc.	E. 9th St., Cleveland, Ohio President: Ross E. Miller Vice-President: Lloyd Brown	3 D.H. Dove 1 D.H. Heron	750	7,200,000 pass-miles	18,000	—	75,000	Formerly known as Taxi Air Group.
Trans-Caribbean Airways, Inc.	140 Central Park South, New York 19, N.Y. President and Gen. Manager: O. Roy Chalk Director of Ops.: A. J. Cohen	3 Douglas DC-6B 3 Douglas DC-4 2 Curtiss DC-6 *On order:* 1 Douglas DC-8	—	—	—	—	—	Scheduled operations New York/San Juan commenced on March 8, 1958.
Transocean Air Lines	Metropolitan Oakland International Airport, Oakland 4, California President: Orvis M. Nelson Exec. Vice-President: E. W. Ringo	2 Lockheed L-1049H Super Constellation 5 Douglas DC-4 3 Grumman Albatross 1 Beechcraft	—	2,436,181 *3,606,866*	31,031 *9,212*	55,718 *409,532*	813,199 *8,532,279*	—
Trans-Texas Airways, Inc.	International Airport, Houston 17, Texas President: R. E. McKaughan Vice-President (Ops.): H. E. Erdmann	20 Douglas DC-3	4,183	—	—	—	—	—
Trans World Airlines, Inc. (T.W.A.)	1735, Baltimore, Kansas City, 8, Missouri President: Charles S. Thomas Chairman: Warren Lee Pierson	25 Lockheed L-1649A Starliner 28 Lockheed L-1049G Super Constellation 13 Lockheed L-1049 Super Constellation 71 Lockheed L-049 and L-749 Constellation 48 Martin 202 and 404 8 Douglas DC-4 1 Fairchild C-82 *On order:* 15 Boeing 707-131 18 Boeing 707-331 30 Convair 880	48,000	118,636,000 N/A	4,818,000 N/A	33,988,000 N/A	71,488,000 N/A	—
United Air Lines Inc. (U.A.L.)	5959 S. Cicero Avenue, Chicago 38, Illinois President: W. A. Patterson	5 Douglas DC-6A 37 Douglas DC-6B 42 Douglas DC-6 48 Douglas DC-7 53 Convair 340 *On order:* 12 Douglas DC-7 2 Douglas DC-6A 11 Boeing 720 40 Douglas DC-8	14,000	124,625,000 *5,745,000*	6,626,570 *40,209*	29,754,000	86,950,000 *51,000*	—
West Coast Airlines, Inc.	Boeing Field, Seattle 8, Washington President: Nick Bez Vice-President (Ops.): E. B. Code	14 Douglas DC-3 *On order:* 6 Fairchild F-27	2,394	4,005,290 *25,368*	249,668 *4,394*	703,299	1,052,952	—

Non-scheduled traffic figures in italic type.

Airline	Head Office and Management	Fleet	Route Mileage	Miles Flown 1957	Passengers 1957	Mail (lb.) 1957	Freight (lb.) 1957	Remarks
U.S.A.—*cont.*								
Western Air Lines, Inc.	Los Angeles International Airport, 6060 Avion Drive, Los Angeles 45, Calfornia President: Terrell C. Drinkwater Vice-President (Ops.): Stanley R. Shatto	21 Douglas DC-6B 9 Convair 240 5 Douglas DC-3 *On order:* 9 Douglas DC-6B 9 Lockheed Electra	9,153	21,896,000	1,379,653	10,734,000	12,340,000	—
VENEZUELA								
Aerovías Venezolanas, S.A. (AVENSA)	Apartado 943, Caracas President: H. L. Boulton Gen. Manager: Andrés Boulton	17 Douglas DC-3 5 Convair 340 2 Convair 440 3 Curtis C-46 *On order:* 5 Fairchild F-27	6,009	5,458,811 total	338,842 total	—	17,103,652 *9,232,069*	Pan American World Airways hold a 30% interest.
Linea Aeropostal Venezolana (LAV)	El Silencio, Bloque 1, Caracas President: Coronel Antonia Briceño Linares First Vice-President: Dr. H. Font Viale Rigo	30 Douglas DC-3 1 Lockheed Constellation 4 Curtiss C-46 3 Vickers Viscount 749 2 Martin 202	20,100	8,518,143 *777,198*	319,324 *11,217*	1,095,985	18,004,212 *2,835,836*	—
Rutas Aereas Nacionales, S.A. (RANSA)	8 Piso, Edificio America, Caracas President: Capt. Carlos Chavez H. Ops. Manager: Capt. Ramon Diaz-Borges	13 Curtiss C-46 5 Cessna 180 2 D.H. Beaver 1 Beechcraft DH-50	14,510	5,527,270 *111,700*	—	30,000	41,284,250 *978,242*	Operating only freight services at present.
VIETNAM								
Aigle Azur Extreme Orient	Saigon	6 Boeing 307 Stratoliner 6 Douglas DC-3 1 Bristol Freighter 1 Curtiss C-46 2 D.H. Otter 2 D.H. Beaver	—	—	—	—	—	Formed in Nov. 1955 by merger of Air Azur Indochine and Aero Cargo.
Air Vietnam	116, Boulevard Saigon Nguyen-Hue, President: Nguyen Van Khai Manager: Nguyen Tan Trung	1 Douglas DC-4 6 Douglas DC-3	13,835	1,362,059 *190,143*	99,003 *6,039*	622,415 *6,506*	4,000,440 *550,672*	Vietnam Government has 50% interest. Other 50% held by Air France and local companies.
YUGOSLAVIA								
Jugoslovenski Aerotransport	P.O. Box 749, Bircaninova 1/III Belgrade Gen. Manager: Milan Simonic Commercial Manager: Gojko Vojvodic	13 Douglas DC-3 1 Convair 340 2 Convair 440 6 Ilyushin Il-14 *On order:* 2 Douglas DC-6B	9,560	1,916,442 *114,419*	109,332 *2,342*	1,081,633 *11,543*	1,255,026 *84,133*	State-owned.

Non-scheduled traffic figures in italic type.

ALL THE WORLD'S AEROPLANES

(CORRECTED TO SEPTEMBER 30, 1958).

SOME FIRST FLIGHTS MADE DURING THE PERIOD SEPTEMBER 1, 1957 — AUGUST 31, 1958

1957

September

4 Lockheed JetStar (U.S.A.)
12 SZD S-4 Kania-2 (Poland)
14 Dassault Etendard VI (2nd Prototype) (France)
23 I.A.45 (Argentine Republic)
25 NU-225 Sikumbang (Indonesia)

October

11 Hispano Ha.1110-MIL (Spain)
21 Piper PA-42 Comanche (1st production) (U.S.A.)

November

6 Fairey Rotodyne (G.B.)
20 Vertol 105 (U.S.A.)
26 Piaggio P.166 (Italy)

December

2 Temco TT-1 Pinto (1st production) (U.S.A.)
3 Avions Fairey Tipsy Nipper (Belgium)
6 Lockheed Electra (U.S.A.)
10 Macchi M.B.326 (Italy)
13 Colonial C-2 Skimmer IV (U.S.A.)
18 Saunders-Roe S.R.-53 (2nd prototype) (G.B.)
18 Callair A-4 180 (U.S.A.)
20 Superior Satellite (U.S.A.)
20 Boeing 707-121 (1st production) (U.S.A.)
23 I.A.46 (Argentine Republic)
23 Vickers Viscount 810 (G.B.)

1958

January

11 Bristol Britannia 314 (1st production) (G.B.)
17 Aviamilano F.14 Nibbio (Italy)
18 Breguet 1001 Taon (2nd prototype) (France)
19 Fuji T1F2 (Japan)
20 Nord 3400 (France)
20 Martin YP6M-1 Seamaster (U.S.A.)
25 Aer Lualdi L.55 (Italy)
31 North American T2J-1 (U.S.A.)

February

8 RWF RW.3 Multoplane (1st production) (Germany)
9 Dassault Super-Mystere B.4 (France)
11 Max Holste M.H. 1522 Super Broussard (France)
13 Lockheed Electra (2nd production) (U.S.A.)
15 Saab-35A Draken (1st production) (Sweden)
22 Auster Workmaster (G.B.)
27 Morane-Saulnier M.S. 760 Paris (1st production) (France)

March

11 Handley Page Dart Herald (G.B.)
15 Antonov AN.14 Pchelka (U.S.S.R.)
21 Chance Vought F8U-2 Crusader (U.S.A.)
23 Fokker F.27 Friendship (1st production) (Netherlands)

1958

March

25 Avro Arrow (Canada)
27 Aerfer Ariete (Italy)

April

3 Lockheed JetStar (2nd prototype) (U.S.A.)
9 Convair F-106B Delta Dart (U.S.A.)
15 Fairchild F-27 (U.S.A.)
17 NU-85 Belalang (Indonesia)
24 SIPA 1100 (France)
27 D.H. Comet 4 (1st production) (G.B.)
30 Blackburn N.A.39 (G.B.)

May

2 Kaman K-17 (U.S.A.)
9 Gloster Javelin Mk. 8 (G.B.)
12 Morane-Saulnier Epérvier (France)
12 Dassault Mirage IIIA (1st pre-production) (France)
18 Sud-Aviation S.E.210 Caravelle (1st production) (France)
21 Dassault Etendard IVM (France)
21 PZL 102 (Poland)
21 Breguet Type 940 (France)
26 Sikorsky HSS-IN (U.S.A.)
27 McDonnell F4H-1 (U.S.A.)*
30 Douglas DC-8 (U.S.A.)

June

2 Chance Vought F8U-3 Crusader III (U.S.A.)
5 Sud-Aviation S.E.116 Voltigeur (France)
9 Agusta AZ8-L (Italy)
15 Westland Westminster Utility (G.B.)
20 Westland Wessex (1st pre-production) (G.B.)
26 PZL M-2 (Poland)

July

4 Normande Jodel D.140 Mousquetaire (France)
5 Bristol 192 (G.B.)
8 Borgward-Focke Kolibrie (Germany)
20 Saunders-Roe P.531 (G.B.)
21 Goodyear ZPG-3W airship (U.S.A.)
27 D.H. Comet 4 (2nd production) (G.B.)
27 English Electric Canberra P.R.9 (1st production) (G.B.)
30 D.H.C.4 Caribou (Canada)

August

6 First German-built Nord Noratlas (Germany)
14 Grumman Gulfstream (U.S.A.)
20 Fairey Gannet AEW. Mk. 3 (G.B.)
21 D.H. Comet 3B (G.B.)
31 Scottish Aviation Twin Pioneer (2 x Pratt & Whitney R-1340) (G.B.)
31 North American A3J-1 Vigilante (U.S.A.)

THE ARGENTINE REPUBLIC

I.A.

FABRICA MILITAR DE AVIONES (INSTITUTO AEROTECNICO).

CORDOBA.

Director: Vice-Comodoro Jorge Sixto Fernandez.

The Fabrica Militar de Aviones was established at Cordoba in 1927 and at the outset built aircraft and aero-engines of various foreign designs under licence. It began the design and manufacture of aircraft of its own design in 1932.

Important products of this factory have included the Pulqúi I, the first jet-propelled aircraft to be designed, built and flown in Latin America; and the Pulqúi II, the first Latin American swept-wing jet fighter. The former flew for the first time on August 9, 1947, and the latter on June 27, 1950. Both have been described fully in earlier editions of "All the World's Aircraft."

Other interesting products of the Cordoba factory have included two tail-less gliders designed by the German Dr. Reimar Horten, who is technical adviser to the organisation.

Under Dr. Horten's guidance, a new programme is under way to develop a high-speed delta-wing aircraft in three stages, beginning with a glider and progressing through an intermediate medium-speed powered aircraft stage to the final version. All three types are covered by the designation I.A.37. The glider has completed its initial test flights, while the intermediate version was, at the time of writing, approaching completion.

Also under development is a large four-engined tail-less monoplane, or "flying wing," known as the I.A. 38. This has also been designed by Dr. Horten.

In addition, the factory has designed and built the prototypes of a twin-engined civil executive transport known as the I.A. 45 and an agricultural aircraft designated the I.A. 46. Details of these new types are given below.

Current production is centered on the I.A.35 twin-engined general-purpose monoplane and the Beechcraft T-34 Mentor, of which 75 are being assembled under licence from Beech Aircraft Corporation of Wichita, Kansas. Assembly, also under licence, of 48 Morane-Saulnier M.S. 760 Paris twin-jet liaison aircraft was scheduled to start in 1958.

A total of 8,500 persons is employed at the Fabrica Militar de Aviones.

THE I.A. 46.

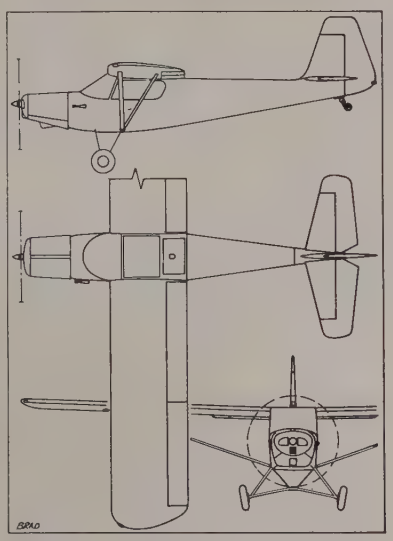
The I.A. 46 is a light monoplane designed for agricultural use or as a three-seat tourer. The prototype made its first flight on December 23, 1957.

TYPE.—Single-engined Light monoplane.

WINGS.—High-wing rigidly-braced monoplane. NACA 23012 wing section. Aspect ratio 7.5. Chord 1.60 m. (5 ft. 3 in.) constant. Dihedral 1° 30′. Incidence 3° 30′. Two-spar aluminium-alloy structure



The I.A. 46 two-seat Light Monoplane (150 h.p. Lycoming O-320 engine).



The I.A. 46.

covered with fabric. Frise-type ailerons. Flaps inboard of ailerons. Total area of flaps 3.08 m.² (33.1 sq. ft.). Total area of ailerons 2.68 m.² (28.8 sq. ft.). Gross wing area 18 m.² (193.7 sq. ft.).

FUSELAGE.—Fabric-covered welded steel-tube structure.

TAIL UNIT.—Braced monoplane type. Welded steel tube frames, fabric covering. Trim-tab in elevators. Areas: fin 0.735 m.² (7.9 sq. ft.), rudder 0.84 m.² (9.03 sq. ft.), tailplane 1.34 m.² (14.4 sq. ft.), elevators 1.24 m.² (13.3 sq. ft.). Tailplane span 3.40 m. (11 ft. 2 in.).

LANDING GEAR.—Divided type. Oleo/rubber shock absorbers. Hydraulic disc brakes. Track 1.85 m. (6 ft.).

POWER PLANT.—One 150 h.p. Lycoming O-320 four-cylinder horizontally-opposed air-cooled engine. Sensenich two-blade metal airscrew. Fuel tank in each wing root. Total fuel capacity 140 litres (30.7 Imp. gal.).

ACCOMMODATION.—Enclosed cabin seating pilot centrally in front and two passengers on bench seat aft. Tandem dual controls. Door on right side, sliding windows on left. Baggage compartment behind rear seat. Provision for installation of spraying or dusting equipment with a tank capacity of 500 litres (110 Imp. gal.).

DIMENSIONS.—
Span 11.60 m. (38 ft.).
Length 7.45 m. (24 ft. 5 in.).
Height 2.15 m. (7 ft.).

WEIGHTS (Tourer).—
Weight empty 560 kg. (1,232 lb.).
Disposable load 370 kg. (814 lb.).
Weight loaded 930 kg. (2,046 lb.).

WEIGHTS (Agricultural).—
Weight empty 600 kg. (1,320 lb.).
Disposable load 400 kg. (880 lb.).
Weight loaded 1,000 kg. (2,200 lb.).

PERFORMANCE.—
Max. speed 195 km.h. (119 m.p.h.).
Cruising speed 170 km.h. (105.5 m.p.h.).
Landing speed (with flaps) 60 km.h. (37.2 m.p.h.).
Rate of climb at S/L 216 m./min. (710 ft./min.).
Service ceiling 4,000 m. (13,120 ft.).
Endurance 4 hours.
Cruising speed (75% power) 260 km.h. (161 m.p.h.).
Rate of climb at S/L 390 m./min. (1,280 ft./min.).
Absolute ceiling 6,500 m. (21,320 ft.).
Single-engined ceiling 2,300 m. (7,540 ft.).
Stalling speed with flaps 94 km.h. (58.3 m.p.h.).
Cruising range (with reserve fuel for 30 min. flight, 75% power) 1,000 km. (620 miles).

THE I.A. 45.

The I.A. 45 is a light twin-engined executive transport, the prototype of which made its maiden flight on September 23, 1957.

TYPE.—Twin-engined Light Transport.

WINGS.—High-wing cantilever monoplane. Wing section NACA 23016 at root, 23010 at tip. Aspect ratio 9.7. Chord 1.759 m. (5 ft. 9 in.) at root, 1.056 m. (3 ft. 5½ in.) at tip. Dihedral 4°. Incidence 4° at root, 1° at tip. All-metal single-spar structure with torsion-box leading-edge. All-metal ailerons and split flaps. Total area of flaps 1.674 m.² (18 sq. ft.). Total area of ailerons 1.53 m.² (16.5 sq. ft.). Gross wing area 19 m.² (204.4 sq. ft.).

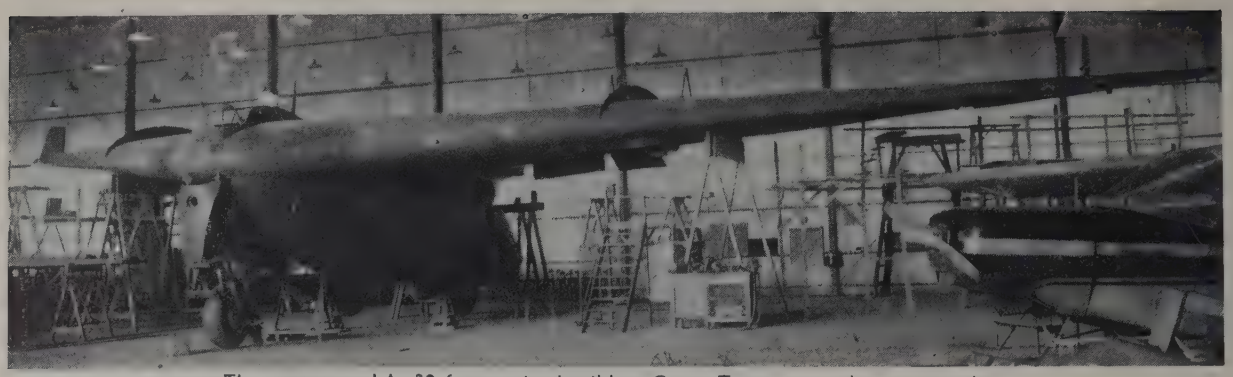
FUSELAGE.—All - metal semi - monocoque structure.

TAIL UNIT.—Cantilever tailplane and end-plate fins and rudders. Fixed surfaces are all metal, one-piece elevator and rudders have metal frames and fabric covering. Areas: fins 1.808 m.² (19.4 sq. ft.), rudders 1.732 m.² (18.6 sq. ft.), tailplane 2.316 m.² (24.9 sq. ft.), elevator 1.878 m.² (20.2 sq. ft.). Tailplane span 3.68 m. (12 ft.).

LANDING GEAR.—Retractable tricycle type. Main wheels retract with sides of fuselage. Oleo-pneumatic shock-absorbers. Hydraulic retraction. Goodyear wheels, tyres and brakes. Wheelbase 3.018 m. (9 ft. 10 in.). Track 2.14 m. (7 ft.).



The I.A. 45 Light Executive Transport (two 150 h.p. Lycoming O-320 engines).



The prototype I.A. 38 four-engined tail-less Cargo Transport under construction

Power Plant.—Two 150 h.p. Lycoming O-320 four-cylinder horizontally-opposed air-cooled engines arranged as pushers and driving Hartzell all-metal two-blade constant-speed and feathering propellers. Two integral fuel tanks, one in each wing. Total fuel capacity 300 litres (66 Imp. gallons).

Accommodation.—Enclosed cabin, seats pilot, co-pilot and three passengers, or pilot and four passengers, or pilot, one stretcher case and medical attendant. Dual controls can be fitted. Heating and ventilation. Baggage compartment behind cabin.

Dimensions.—
Span 13.54 m. (44 ft. 5 in.).
Length 8.84 m. (28 ft. 11 in.).
Height 2.80 m. (9 ft. 2 in.).

Weights and Loadings.—
Weight empty 1,084 kg. (2,385 lb.).
Disposable load 566 kg. (1,245 lb.).
Weight loaded 1,650 kg. (3,630 lb.).
Wing loading 86.8 kg./m.² (17.7 lb./sq. ft.).
Power loading 5.5 kg./h.p. (12.1 lb./h.p.).

Performance.—
Max. speed at S/L 284 km.h. (176 m.p.h.).

THE I.A. 38.

Type.—Four-engined "tail-less" monoplane Cargo Transport.

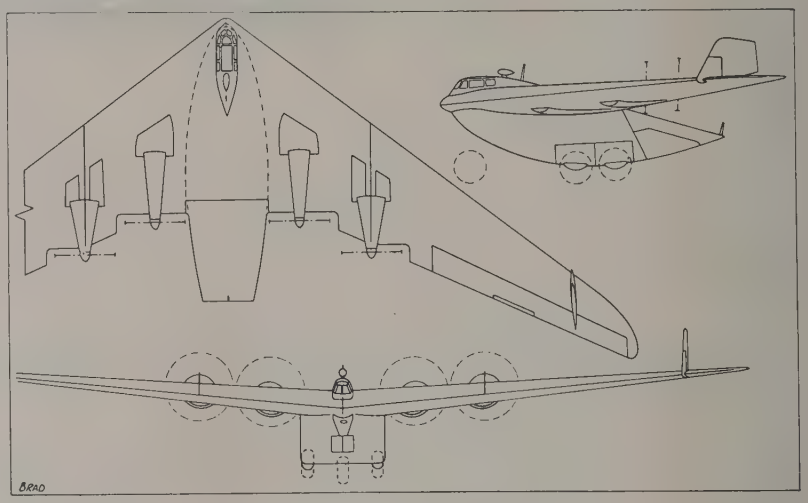
Wings.—Shoulder-wing swept monoplane. Special wing profile, 18% thickness at root and 10.4% at tip. Aspect ratio 7.7. Chord 6.4 m. (20 ft. 11½ in.) at root, 1.6 m. (5 ft. 6 in.) at tip. Dihedral 5.7°. Incidence 9°. Sweepback at leading-edge 36.5°. All-duralumin two-spar semi-monocoque structure. All-metal Frise-type ailerons and split flaps. Total area of ailerons 4.5 m.² (48.4 sq. ft.). Gross wing area 133 m.² (1,431 sq. ft.).

Fuselage.—Incorporated in and below wing.

Vertical Surfaces.—No tail-unit. All-metal fins and balanced rudder near wing tips. Areas (each): fin 0.60 m.² (6.45 sq. ft.), rudder 2.80 m.² (30.1 sq. ft.).

Landing Gear.—Retractable nose-wheel type, all wheels retracting into lower part of fuselage. Hydraulic actuation. Oleo-pneumatic shock-absorbers. Dunlop wheels, tyres and brakes. Wheelbase 4.90 m. (16 ft.). Track 2.80 m. (9 ft. 2 in.).

Power Plant.—Four 450 h.p. I.A. 16 El Gaucho radial air-cooled engines mounted as pushers and driving Rotol fixed-pitch propellers. Provision has been made in the basic structure to instal four 750 h.p. I.A. 19 El Indio engines at a later date. Two fuel tanks (1,450 litres = 320 Imp. gallons each) in wings.



The I.A. 38 tail-less Cargo Transport.

Accommodation.—Pilot's compartment for two over leading-edge of wing. Large compartment capable of accommodating 6 tons of cargo within and below wing. Rear loading door. Can be adapted for troop transport, etc.

Dimensions.—
Span 32 m. (105 ft.).
Length 13.5 m. (44 ft. 3 in.).
Height 4.6 m. (15 ft.).

Weights (4 × 450 h.p. I.A. 16 engines).—
Weight empty 8,500 kg. (18,700 lb.).
Weight loaded 16,000 kg. (35,200 lb.).

Weights (4 × 750 h.p. I.A. 19 engines).—
Weight empty 9,000 kg. (19,800 lb.).
Weight loaded 20,500 kg. (45,100 lb.).

Performance (4 × 450 h.p. I.A. 16 engines—estimated).—
Max. speed 252 km.h. (156.5 m.p.h.).
Cruising speed 215 km.h. (133.5 m.p.h.).
Landing speed 140 km.h. (87 m.p.h.).
Ceiling 4,500 m. (14,760 ft.).
Range and duration 1,250 km. (776 miles) or 5.6 hours.

Performance (4 × 750 h.p. I.A. 19 engines—estimated).—
Max. speed 320 km.h. (200 m.p.h.).
Cruising speed 245 km.h. (152 m.p.h.).
Rate of climb at S/L 168 m./min. (550 ft./min.).

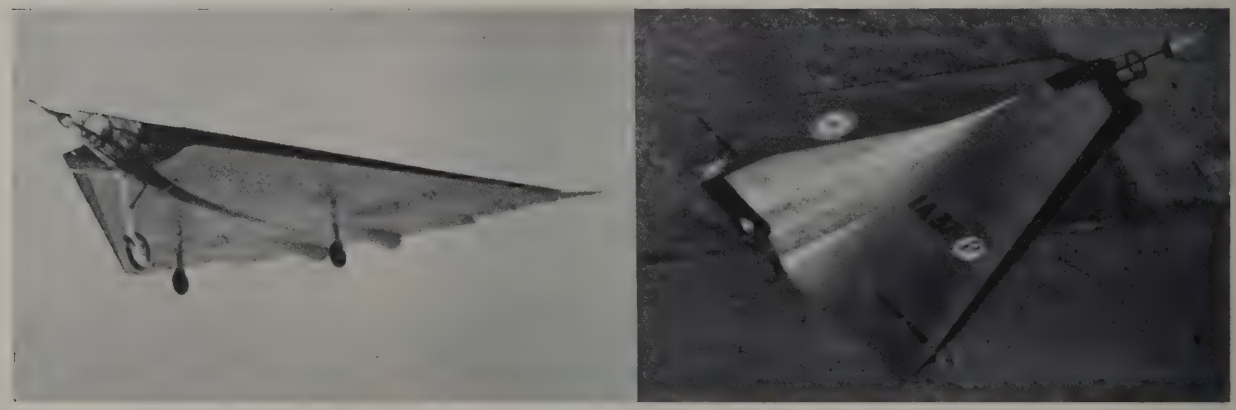
THE I.A. 37.

Most important current project of the Fabrica Militar de Aviones is the development of a high-speed delta-wing aircraft known as the I.A.37. As the first stage, a glider of the same form and dimensions as the powered aircraft has been built and flight-tested. Next comes an all-metal powered version for tests at medium speeds, the prototype of which was, at the time of writing, nearing completion. This will be followed by a fully developed high-speed version.

The following details apply to the medium-speed version.

Type.—Single-seat Research monoplane.

Wings.—Cantilever mid-wing delta monoplane. Symmetrical profile. Leading-edge sweep-back 63.5°. No dihedral or incidence. All-metal multi-spar structure of semi-monocoque construction. All-metal statically and aero-dynamically balanced ailerons



Two views of the full-size engineless test vehicle for the I.A. 37 high-speed delta-wing monoplane.

inset from tips. Area of ailerons 2.4 m.² (25.8 sq. ft.). Gross wing area 48 m.² (516 sq. ft.),

FUSELAGE.—All-metal semi-monocoque cockpit nacelle only.

TAIL UNIT.—Cantilever monoplane fin and rudder only. Fin sweepback 72°. Areas: fin 3.3 m.² (35.5 sq. ft.), rudder 1.1 m.² (11.8 sq. ft.).

LANDING GEAR.—Retractable tricycle type. Hydraulic retraction. Oleo-pneumatic shock-absorbers. Wheelbase 4.25 m. (13 ft. 11 in.). Track 4.65 m. (15 ft. 3 in.).

POWER PLANT.—One Rolls-Royce Derwent 5 turbojet engine (1,633 kg.=3,600 lb. s.t.). All fuel in two internal wing tanks. Total capacity 1,700 litres (375 Imp. gallons).

ACCOMMODATION.—Cockpit nacelle for pilot, equipped with ejector seat.

DIMENSIONS.—
Span 10 m. (32 ft. 9 in.).
Length 11 m. (36 ft.).
Height 3.6 m. (11 ft. 9½ in.).

WEIGHTS (designed).—
Weight empty 2,800 kg. (6,160 lb.).
Weight loaded 4,500 kg. (9,900 lb.).

PERFORMANCE (estimated).—
Max. speed 800 km.h. (500 m.p.h.) at 8,000 m. (26,250 ft.).
Cruising speed 750 km.h. (466 m.p.h.).
Landing speed 110 km.h. (68 m.p.h.).
Service ceiling 11,000 m. (36,080 ft.).
Range 2,000 km. (1,240 miles).
Endurance 2.8 hours.

THE I.A. 35 HUANQUERO.

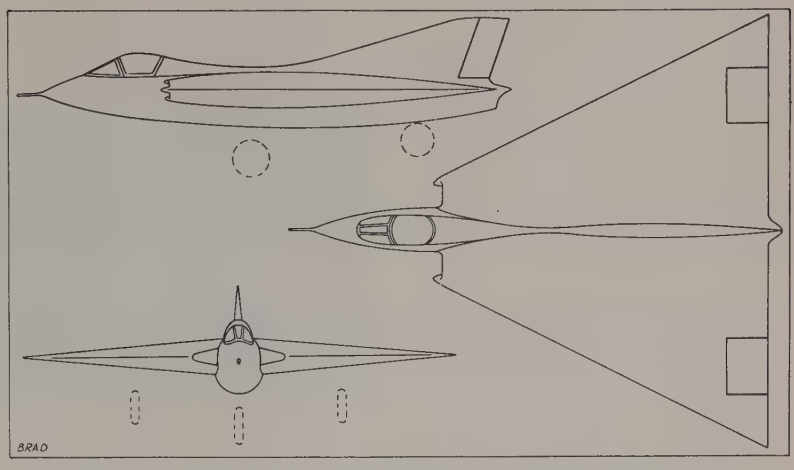
The I.A.35, which is in production, is a twin-engined aircraft designed to fulfil a multiplicity of duties.

The following are the principal versions :—

Type IA. Advanced trainer. For navigation training carries pilot, co-pilot, radio operator, instructor and four pupils. Fitted with necessary desks and navigational equipment. Also provided with equipment for instrument flying, communication equipment for short and long range flights, camera and oxygen.

Type IB. Bomber version. Fitted with two 750 h.p. I.A. 19R El Indio engines with corresponding increase in performance (see below). Adapted for training in light bombing, gunnery and rocket firing. Apart from basic navigational and communications equipment, is fitted with two 12.7 mm. Browning machine-guns with 534 rounds; racks for 4 × 50 kg. or 2 × 100 kg. bombs; and racks for 1 × 5 in. or 4 × 2.25 in. rockets under each wing.

Type III. Ambulance version. Can carry crew of three, four patients and medical attendant. Fitted with four stretchers, medical chest and table for doctor.



The first powered version of the I.A.37 Delta-wing Monoplane.

Type IV. Photographic version. Carries normal crew plus camera operator. Fairchild 225 camera equipment.

The prototype I.A. 35 first flew on September 21, 1953, and the first production aircraft made its maiden flight on March 29, 1957.

TYPE.—Twin-engined General Purposes monoplane.

WINGS.—Low-wing cantilever monoplane. Wing section NACA 633-218 at root, 633-212 at tip. Aspect ratio 9. Chord 2.715 m. (8 ft. 11 in.) at root, 1.197 m. (3 ft. 11 in.) at tip. Dihedral 7°. Incidence 3° at root, 1° at tip. Wing in three sections of duralumin semi-monocoque construction. All duralumin split flaps. Metal-framed fabric-covered Frise ailerons. Total area of flaps 4.36 m.² (46.9 sq. ft.). Total aileron area 2.92 m.² (31.4 sq. ft.). Gross wing area 42 m.² (452 sq. ft.).

FUSELAGE.—All - metal semi - monocoque.

TAIL UNIT.—Cantilever monoplane type with twin fins and rudders. Duralumin semi-monocoque structure. Areas: fin 1.65 m.² (17.7 sq. ft.), rudder 0.692 m.² (7.4 sq. ft.), tailplane 4.20 m.² (45.2 sq. ft.), elevator 1.96 m.² (21.0 sq. ft.). Span of tailplane 4.90 m. (16 ft.).

LANDING GEAR.—Retractable nose-wheel type. Hydraulic retraction. Oleo-pneumatic shock-absorbers. Dunlop wheels, tyres and brakes. Wheelbase 3.7 m. (12 ft. 1½ in.). Track 4.86 m. (15 ft. 11½ in.).

POWER PLANT.—Two 620 h.p. I.A. 19R El Indio nine-cylinder radial air-cooled supercharged engines. Rotal three-blade controllable-pitch airscrews. Main fuel tanks in wings. Total fuel capacity 1,200 litres (265 Imp. gallons). Provision for one 650 litre (143 Imp. gallon) external long-range tank.

ACCOMMODATION.—Crew in forward section of fuselage, cabin in centre section. Accommodation varies according to function of aircraft. See introduction.

DIMENSIONS.—
Span 19.6 m. (64 ft. 3 in.).
Length 13.98 m. (45 ft. 10 in.).

WEIGHTS.—
Weight empty 3,500 kg. (7,700 lb.).
Average loaded weight 5,700 kg. (12,540 lb.).

PERFORMANCE (2 × 620 h.p. I.A. 19R engines).—
Max. speed 362 km.h. (225 m.p.h.) at 3,000 m. (9,840 ft.).
Max. cruising speed 350 km.h. (217 m.p.h.) at 3,000 m. (9,840 ft.).
Econ. cruising speed 320 km.h. (200 m.p.h.) at 300 m. (984 ft.).
Rate of climb at S/L 300 m./min. (984 ft./min.).
Service ceiling 6,400 m. (21,000 ft.).
Absolute ceiling 6,600 m. (21,650 ft.).
Max. range or endurance (internal fuel) 1,570 km. (975 miles) or 4 hrs. 40 mins.
Max. endurance (with L/R tank) 7 hrs. 40 min.

PERFORMANCE (2 × 750 h.p. I.A. 19R engines).—
Max. speed 380 km.h. (236 m.p.h.).
Max. cruising speed 355 km.h. (220 m.p.h.).
Econ. cruising speed 330 km.h. (205 m.p.h.).
Rate of climb at S/L 396 m./min. (1,300 ft./min.).
Service ceiling 6,500 m. (21,320 ft.).
Max. range or endurance 1,450 km. (900 miles) or 4 hrs. 38 min.



The first four production versions of the I.A. 35 twin-engined General Purpose Monoplane.

AUSTRIA

OFW

ÖSTERREICHISCHES FLUGZEUGWERK G.m.b.H.

HEAD OFFICE: SALESIANERGASSE 1, VIENNA.

AERODROMES: ASPERN AND WIENER-NEUSTADT.

This company has built the prototype of a side-by-side two-seat light aeroplane, known as the OK-15, which was the first powered aircraft produced in Austria since the war.

Built entirely of commercially-available Austrian materials, except for its engine and tyres, the standard OK-15 is fully aerobatic and is suitable for *ab initio* and aerobatic training, touring, glider and banner towing and other duties. A de luxe version with dynamo, starter, starter battery and lighting for night flying is also available; but this version is not aerobatic.



The OFW OK-15 Light Monoplane (105 h.p. Walter Minor 4-III engine).

THE OFW OK-15.

TYPE.—Two-seat Cabin monoplane.

WINGS.—Cantilever low-wing monoplane. Aspect ratio 5.25. Composite construction, with single steel box-spar and wooden ribs. Plywood covering, except for under-surface which is fabric-covered aft of spar. All-wood ailerons with controllable trim tabs. Metal flaps with fabric covering. Wing area 11 m.² (118 sq. ft.).

FUSELAGE.—Tubular-steel structure, with metal covering from fireproof bulkhead to trailing edge of wing and plywood covering aft of wing.

TAIL UNIT.—Cantilever monoplane type. Metal structure with fabric-covering.

LANDING GEAR.—Non-retractable tail-wheel type. Cantilever main wheel units. Hydraulic brakes. Main wheel tyres 380 × 150 mm. (15.00 × 6 in.). Steerable tail-wheel swivels through 360°.

POWER PLANT.—One Walter Minor 4-III four-cylinder inverted in-line air-cooled engine giving 105 h.p. for take-off and a continuous output of 80 h.p. at 2,300 r.p.m. Two-blade fixed-pitch wooden air-screw. 90 litre (19.8 Imp. gallon) fuel tank in fuselage aft of firewall.

ACCOMMODATION.—Two seats side-by-side, with dual controls, under jettisonable transparent canopy. Luggage space aft of seats.

DIMENSIONS.—
Span 7.60 m. (24 ft. 11 in.).
Length 6.50 m. (21 ft. 4 in.).
Height 1.73 m. (5 ft. 8 in.).

WEIGHTS AND LOADINGS.—
Weight empty 504 kg. (1,111 lb.).
Max. loaded weight 788 kg. (1,737 lb.).
Wing loading 71.63 kg./m.² (14.67 lb./sq. ft.).
Power loading 7.5 kg./h.p. (16.5 lb./h.p.).

PERFORMANCE (at max. A.U.W.).—
Max. speed at 300 m. (985 ft.) 202 km.h. (125 m.p.h.).
Cruising speed at 300 m. (985 ft.) 180 km.h. (112 m.p.h.).
Landing speed 75 km.h. (46.5 m.p.h.).
Rate of climb at S/L. 200 m./min. (655 ft./min.).
Time to 1,000 m. (3,280 ft.) 6 min. 45 sec.
Service ceiling 4,100 m. (13,450 ft.).
Take-off run on grass 200 m. (655 ft.).
Landing run on grass 110 m. (360 ft.).
Range 630 km. (390 miles).
Endurance with reserve 3½ hours.

BELGIUM

AVIONS FAIREY

AVIONS FAIREY S.A.

HEAD OFFICE, WORKS AND AERODROME: GOSSELIES, NEAR CHARLEROI.

Managing Director: Mr. E. O. Tips, A.F.R.Ae.S., C.O.C.

This Belgian company was formed in 1931 as a subsidiary of the English Fairey Aviation Co., Ltd.

In recent years, Avions Fairey has expanded its facilities very considerably in order to cope with the construction of a substantial number of Hawker Hunter Mk. 4 and Mk. 6 fighters for N.A.T.O. and the Belgian Air Force.

The company also has a contract for the IRAN (Inspection and Repair As Necessary) of a large number of F-84F Thunderstreak aircraft for the Belgian Air Force.

In addition to this military work, Avions Fairey has resumed the development of light aircraft designed by its Managing Director, Mr. E. O. Tips. As a start, it is producing a completely new ultra-light single-seater named the Tipsy Nipper, both as a ready-to-fly aircraft and in the form of kits of parts for assembly by amateurs. It is also developing a new version of the Tipsy Junior single-seat light aircraft (described in previous editions of "All the World's Aircraft") with a 65 h.p. Continental engine in place of the original 62 h.p. Walter Mikron.

THE AVIONS FAIREY T.66 TIPSY NIPPER.

Intended mainly for sale in kit form, for assembly by amateurs, the Tipsy Nipper is a simple, low-cost ultra-light single-seater powered by a converted Volkswagen or Porsche motor-car engine. The prototype flew for the first time on December 3, 1957, and the first kits of parts and complete aircraft were expected to be ready for delivery in the summer of 1958.

TYPE.—Single-seat Ultra-light Monoplane.

WINGS.—Cantilever shoulder-wing monoplane. Modified NACA 43012A wing section. Aspect ratio 4.8. Chord 1.25 m. (4 ft. 1½ in.). Dihedral 5° 30′. Incidence 2°. All-wood one-piece single-spar structure, with plywood-covered leading-edge and fabric covering aft of spar. Wooden ailerons. Portion of port wing-root trailing-edge is made of light alloy and hinged, with built-in footrest, so that it can be folded down to assist access to cockpit. Wing is quickly-removable, to permit aircraft to be towed behind a motor car. Total area of ailerons 0.83 m.² (8.93 sq. ft.). Wing area 7.50 m.² (80.7 sq. ft.).

FUSELAGE.—Welded steel-tube structure. Engine cowling and under-fuselage fairing of fiberglas. Rear fuselage fabric-covered.

TAIL UNIT.—Braced monoplane type. Tailplane and elevators of wood construction. No fin. Rudder of steel-tube construction with fabric covering. Areas: rudder 0.7 m.² (7.5 sq. ft.), tailpane 0.85 m.² (9.2 sq. ft.), elevators 0.53 m.² (5.7 sq. ft.). Tailplane span 2.13 m. (7 ft.).

LANDING GEAR.—Non-retractable tricycle type. Nieman transverse rubber-ring shock-absorbers. Steerable nose-wheel. Disc brakes. Wheel track 1.40 m. (4 ft. 7 in.). Wheelbase 1.10 m. (3 ft. 7 in.).

POWER PLANT.—One 30 h.p. modified Volkswagen four-cylinder horizontally-opposed air-cooled engine, or modified Porsche four-cylinder horizontally-opposed air-cooled motor car or industrial engine. Avions Fairey two-blade fixed-pitch airscrew with fiberglas spinner. Fuel tank between engine and cockpit, capacity 24.25 litres (5.33 Imp. gallons). Oil capacity 2 litres (3.5 Imp. pints).

ACCOMMODATION.—Single-seat in open cockpit.

DIMENSIONS.—
Span 6.0 m. (19 ft. 8 in.).
Length 4.5 m. (14 ft. 9 in.).
Height 1.6 m. (5 ft. 3 in.).

WEIGHTS.—
Weight empty 165 kg. (360 lb.).
Weight loaded 300 kg. (660 lb.).

PERFORMANCE (Volkswagen engine).—
Max. speed 120 km.h. (75 m.p.h.).
Cruising speed 105 km.h. (65 m.p.h.).
Take-off distance 135 m. (440 ft.).
Landing distance 90 m. (295 ft.).
Max. range 300 km. (187 miles).



The Avions Fairey T-66 Tipsy Nipper (30 h.p. Volkswagen engine).

SABCA

SOCIÉTÉ ANONYME BELGE DE CONSTRUCTIONS AÉRONAUTIQUES.

HEAD OFFICE : 1,470 CHAUSSÉE DE HAECHT, HAREN-BRUSSELS.

WORKS : HAREN-BRUSSELS AND GOSSELIES.

The Société Anonyme Belge de Constructions Aéronautiques was, before the late war, the largest aircraft works in Belgium. In addition to building aircraft and aero-engines under licence for the Belgian Government and the S.A.B. E.N.A.company, it also designed and built aircraft of original design.

To-day, at its Haren works, it is completing the manufacture under licence of wings for Hawker Hunter single-seat fighters for the Belgian Government. It is also producing aircraft components and assemblies under sub-contract to manufacturers in France, the Netherlands and Italy. A specially-equipped machine-shop is devoted to the production of landing gear and hydraulic components for aircraft and guided missiles.

The company's Gosselies works is engaged on overhaul and repair of military aircraft for the Belgian Air Force, other European air forces and the U.S. Government.

A special team from the SABCA design office is working in co-operation with other Belgian industrial groups on guided missile projects.

SABCA employs a total of 1,600 persons, of whom 850 are production workers at the Haren factory and 250 at Gosselies.

BRAZIL

FOKKER

FOKKER INDÚSTRIA AERONÁUTICA S.A.

HEAD OFFICE : RUA DA ASSEMBLEIA 11 (SALA 503), RIO DE JANEIRO.

WORKS : GALEÃO AIRPORT, RIO DE JANEIRO.

This company was formed with the assistance of the Brazilian Government, and occupies the former Government factory on the Galeão Airport in return for a small annual payment. The Dutch Fokker company has a financial interest in the Brazilian company, which holds production licences for the S.11, S.12 and S.14 trainers. The parent company has provided jigs and tools for production.

The company has received initial orders from the Brazilian Government for 100 S.11 Instructors, 50 S.12's and 50 S.14 Mach-Trainer I's to be powered by Rolls-Royce Derwent engines.



The first Brazilian-built Fokker S.11 (190 h.p. Lycoming O-435 engine).

Of these aircraft, 48 S.11's had been delivered by the end of 1957, when production of the S.12 and S.14 had also started. The possibility of producing the Fokker F-27 Friendship airliner in Brazil is under consideration.

I.P.T.

INSTITUTO DE PESQUISAS TECNOLOGICAS (Institute of Technical Research).

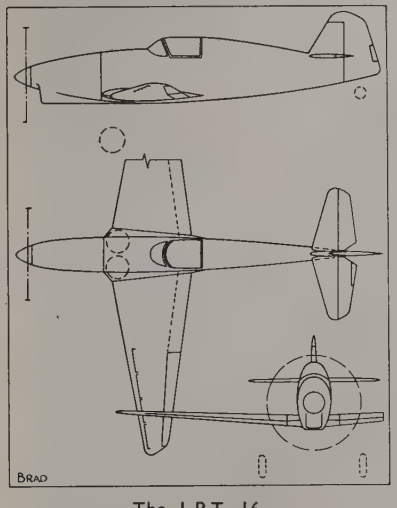
HEAD OFFICE : PRAÇA CEL. FERNANDO PRESTES, 110, CAIXA POSTAL 7141, SÃO PAULO.

Director of the Institute : Prof. F. J. H. Maffei.

Chief of the Aeronautical Section : Eng. Romeu Corsini.

This establishment, which is principally engaged in research, particularly with regard to the qualities of national materials suitable for use by the Brazilian Aircraft Industry, has designed and built a number of prototypes of light aircraft, sailplanes and gliders. These are mainly experimental prototypes and are not intended for commercial production. They employ materials and equipment of national origin, notably structural members, plywood and airscrews of indigenous timbers, the qualities of which are being investigated by the I.P.T.

The types I.P.T. 0 to I.P.T. 14 have been described in previous editions of "All the World's Aircraft." The latest designs are the I.P.T. 16 single-seat light cabin monoplane and the I.P.T. 17, a high-performance sailplane.



The I.P.T. 16.

THE I.P.T. 16.

TYPE.—Single-seat Light Cabin monoplane.

WINGS.—One-piece cantilever low-wing monoplane. Aspect ratio 7.4. Taper ratio 1 : 0.25. Two-spar wooden structure with plywood covering. Mechanically-operated split trailing-edge flaps between ailerons and fuselage. Letterbox fixed slots in wings ahead of ailerons. Wing area 86.4 sq. ft. (8.0 m.²).

FUSELAGE.—Wooden monocoque structure with stressed plywood skin.

TAIL UNIT.—Cantilever monoplane type. Wooden structure with plywood covering on rudder and elevators. Controllable trim-tab in starboard elevator.

LANDING GEAR.—Retractable tail-wheel type. Each main wheel is carried in half-fork on oleo-spring shock-absorber leg, is retracted inwards under wing and fuselage and is contained in well projecting ahead of leading-edge. Mechanical operation. Hydraulic brakes. Non-retractable tail-wheel.

POWER PLANT.—One 160 h.p. inverted four-cylinder air-cooled engine driving a two-blade wooden airscrew. Fuel capacity 120 litres (26.4 Imp. gallons).

DIMENSIONS.—
Span 7.7 m. (25 ft. 2 in.).
Length 7.0 m. (23 ft.).
Height 2.1 m. (6 ft. 11 in.).

WEIGHTS AND LOADINGS.—
Weight empty 440 kg. (970 lb.).
Disposable weight 200 kg. (440 lb.).
Weight loaded 640 kg. (1,410 lb.).
Wing loading 80.5 kg./m.² (16.5 lb./sq. ft.).
Power loading 4 kg./h.p. (8.8 lb./h.p.).

PERFORMANCE.—
Max. speed 340 km./h. (212 m.p.h.).
Cruising speed 300 km./h. (187 m.p.h.).
Stalling speed 90 km./h. (56 m.p.h.).
Endurance 3.5 hrs.
Range 1,050 km. (650 miles).

THE I.P.T. 17.

TYPE.—Single-seat High-performance Sailplane.

WINGS.—Cantilever monoplane. NACA 643-618 wing section. Aspect ratio 22. Chord 1.33 m. (4 ft. 4 in.) at root, 0.39 m. (1 ft. 4 in.) at tip. Dihedral 2° 30′. Incidence 4° 30′. All-wood monospar semi-monocoque structure with stressed plywood skin. All-wood Fowler type flaps. Differentially-controlled top-hinged all-wood ailerons. Area of flaps 2.0 m.² (21.5 sq. ft.). Area of ailerons 1.4 m.² (15 sq. ft.). Gross wing area 16.4 m.² (175 sq. ft.).

FUSELAGE.—All-wood monocoque structure with plywood skin. Width of fuselage 0.6 m. (2 ft.).

TAIL UNIT.—Cantilever monoplane type. Wood structure with plywood-covered fixed surfaces and fabric-covered elevators and rudder. Controllable trim-tab in starboard elevator. Areas : fin 0.186 m.² (2 sq. ft.), rudder 0.9 m.² (9.6 sq. ft.), tailplane 1.31 m.² (12.2 sq. ft.), elevators 0.79 m.² (8.5 sq. ft.). Tailplane span 3.2 m. (10 ft. 6 in.).

LANDING GEAR.—Permanent central skid. Auxiliary detachable gear for take-off.

ACCOMMODATION.—Enclosed cockpit for pilot with moulded Plexiglas canopy conforming to lines of fuselage.

DIMENSIONS.—
Span 19 m. (62 ft. 6 in.).
Length 7.70 m. (25 ft.).
Height overall 1.44 m. (4 ft. 8 in.).

WEIGHTS (Designed).—
Weight empty 270 kg. (600 lb.).
Useful load 90 kg. (200 lb.).
Weight loaded 360 kg. (800 lb.).

PERFORMANCE (Estimated).—
Best gliding ratio 1 : 38 at 76 km.h. (47 m.p.h.).
Min. sinking speed 0.53 m./sec. (1 ft. 9 in./sec.) at 61 km.h. (38 m.p.h.).

NEIVA

SOCIEDADE CONSTRUTORA AERONÁUTICA NEIVA, LTDA.

HEAD OFFICE AND WORKS: RUA N.S. DE FATIMA, 360, BOTUCATÚ, SÃO PAULO.

Director: J. C. de Barros Neiva.

This concern has been supplying for several years Neiva-B Monitor two-seat and BN-1 single-seat sailplanes for the Brazilian flying clubs, under the sponsorship of the Brazilian Government. Both types hold the principal Brazilian and South American soaring records, winning consistently, in competition with the best European high-performance sailplanes, the last five Brazilian soaring championships.

Manufacture proceeds of the aforementioned sailplanes and the Paulistinha 56 light aeroplane. The design department has government contracts for the development of a new two-seat training sailplane and a new version of the Paulistinha-56 for liaison duties with the Brazilian Air Force.



The Neiva Paulistinha-56 (90 h.p. Continental C90 engine).

THE NEIVA PAULISTINHA-56.

TYPE.—Two-seat Light Primary Training and Touring monoplane.

WINGS.—High-wing braced monoplane. Wings attached direct to built-in centre-section in top of fuselage and braced to lower longerons by streamline steel-tube Vee struts. Two-spar wooden wing structure with fabric covering. Slotted ailerons. Wing area 17.00 m.² (183 sq. ft.).

FUSELAGE.—Rectangular welded steel-tube framework, fabric-covered over light wood fairing structure.

TAIL UNIT.—Braced monoplane type. Welded steel-tube framework, fabric-covered. Tie-rod bracing above and below tailplane. Horizontal tail area 2.43 m.² (26.16 sq. ft.). Vertical tail area 1.00 m.² (10.76 sq. ft.).

LANDING GEAR.—Divided type. Two side Vees and two inclined half-axles hinged at their inner ends to a Vee cabane below fuselage. Rubber cord springing. Medium-pressure wheels with brakes. Hydraulic wheel brakes. Leaf spring steerable tail-wheel.

POWER PLANT.—One 90 h.p. Continental C90-8F four-cylinder horizontally-opposed air-cooled engine. Two-blade wooden air-screw.

ACCOMMODATION.—Enclosed cabin seating two in tandem with dual controls. Door on starboard side. Space for baggage behind rear seat.

DIMENSIONS.—
Span 10.76 m. (35 ft. 3½ in.).
Length 6.76 m. (22 ft. 2 in.).

WEIGHTS AND LOADINGS.—
Weight empty 390 kg. (860 lb.).
Weight loaded 587 kg. (1,294 lb.).
Wing loading 34.0 kg./m.² (6.96 lb./sq. ft.).
Power loading 6.5 kg./h.p. (14.3 lb./h.p.).

PERFORMANCE (estimated).—
Max. cruising speed 160 km.h. (99 m.p.h.).
Normal cruising speed 145 km.h. (90 m.p.h.)
Landing speed 47 km.h. (29.2 m.p.h.).
Rate of climb at S/L 240 m./min. (785 ft./min.).
Ceiling 4,200 m. (13,780 ft.).
Range 700 km. (435 miles).

THE NIEVA PAULISTINHA-56-B.

The Paulistinha-56-B is similar to the previously described model, but is fitted with a 100 h.p. Lycoming engine in place of the 90 h.p. Continental. It is intended for the use of the civil flying clubs.

THE NEIVA PAULISTINHA-56-C.

Ordered by the Brazilian Air Force, the Paulistinha-56-C is a development of the 56-B for liaison and other military duties. The principal modification, except for the installation of specialised equipment, will provide better visibility from the rear seat, a design change which will alter the external appearance. No further details are available.



A batch of Neiva B-2 Monitor two-seat Sailplanes.

THE NEIVA B-2 MONITOR.

TYPE.—Two-seat medium-performance Sailplane.

WINGS.—Braced high-wing monoplane. Wing section Goettingen 535. Aspect ratio 13.67. Mean chord 1.343 m. (4 ft. 4¾ in.). Dihedral 0° 30′. Incidence (at root) 3°. Single box-spar with plywood-covered torsion-resistant leading-edge. Fabric-covering aft of spar. Normal type wood-framed fabric-covered ailerons. Wood spoiler type flaps. Areas: spoiler flaps 0.315 m.² (3.38 sq. ft.), ailerons (2) 3.124 m.² (33.61 sq. ft.). Gross wing area 18.40 m.² (198 sq. ft.).

FUSELAGE.—Semi-monocoque all-wood structure with steel-tube frames to support wing attachments.

TAIL UNIT.—Semi-cantilever monoplane type. Wood framework with fabric covering. Areas: fin 0.30 m.² (3.23 sq. ft.), rudder 1.32 m.² (14.20 sq. ft.), tailplane 1.30 m.² (13.98 sq. ft.), elevators 3.00 m.² (32.28 sq. ft.). Tailplane span 3.32 m. (10 ft. 11½ in.).

LANDING GEAR.—Front skid and single Goodyear wheel aft of C.G.

ACCOMMODATION.—Cockpit seats two in tandem. Luggage compartment between pilots. Can be flown solo from front seat only.

DIMENSIONS.—
Span 15.86 m. (52 ft.).
Length 7.10 m. (23 ft. 3½ in.).
Height 1.13 m. (3 ft. 9 in.).

WEIGHTS AND LOADINGS.—
Weight empty 210 kg. (462 lb.).
Disposable load 150 kg. (330 lb.).
Weight loaded 360 kg. (792 lb.).
Wing loading 19.5 kg./m.² (3.99 lb./sq. ft.).

PERFORMANCE.—
Stalling speed 52 km.h. (32.3 m.p.h.).
Best gliding speed 67 km.h. (41.6 m.p.h.).
Max. safe speed 145 km.h. (90 m.p.h.).
Best gliding ratio 1 : 21.

THE NEIVA BN-1.

TYPE.—Single-seat High-performance Sailplane.

WINGS.—Cantilever high-wing monoplane. Wing section NACA 4415 at root, NACA 4412 at mid-span and NACA 2R1 12 at tip. Aspect ratio 19. Chord at root 1.28 m.

(4 ft. 2 in.), at tip 0.42 m. (1 ft. 4½ in.). Dihedral 2°. Incidence 4° at root. Single I-spar structure with plywood-covered torsion-resistant leading-edge and upper surface. Fabric covering on undersurface. Wood-framed fabric-covered ailerons with differential control. Wood spoiler flaps. Area of ailerons (2) 2.0 m.² (21.5 sq. ft.). Gross wing area 13.47 m.² (144.9 sq. ft.).

FUSELAGE.—All-wood semi-monocoque structure. Frontal area 0.42 m.² (4.52 sq. ft.).

TAIL UNIT.—Cantilever monoplane type. Wood frames with plywood and fabric covering. Areas: fin 0.35 m.² (3.7 sq. ft.), rudder 0.65 m.² (7.0 sq. ft.), tailplane and elevator 1.60 m.² (17.2 sq. ft.). Tailplane span 3 m. (9 ft. 11 in.).

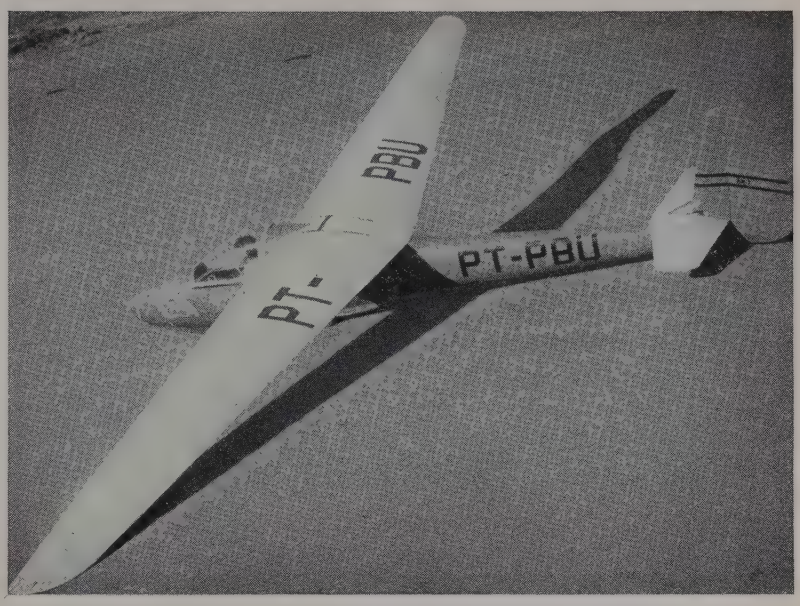
LANDING GEAR.—Front skid and jettisonable wheels aft of C.G.

ACCOMMODATION.—Enclosed cockpit. Moulded Plexiglas canopy.

DIMENSIONS.—
Span 16.0 m. (52 ft. 6 in.).
Length 6.90 m. (22 ft. 7⅛ in.).
Height 1.02 m. (3 ft. 4 in.).

WEIGHTS.—Weight empty 170 kg. (374 lb.).
Disposable load 80 kg. (176 lb.).
Weight loaded 250 kg. (550 lb.).
Wing loading 18.5 kg./m.² (3.79 lb./sq. ft.).

PERFORMANCE.—
Stalling speed 50 km.h. (31 m.p.h.).
Min. sinking speed 0.54 m./sec. (1.7 ft./sec.) at 60 km.h. (37.3 m.p.h.).
Best gliding ratio 1 : 31 at 76 km.h. (47 m.p.h.).
Sinking speed at 100 km.h. (62 m.p.h.) 1.3 m./sec. (4.2 ft./sec.).
Max. safe speed 225 km.h. (140 m.p.h.).



The Neiva BN-1 Single-seat High-Performance Sailplane.

OMAREAL

OFICINA DE MANUTENÇÃO E RECUPERAÇÃO DE AVIOES, LTDA.

HEAD OFFICE AND WORKS: BOTUCATÚ, STATE OF SÃO PAULO.

This company took over flight testing and production of the Casmuniz 52 twin-engined five-seat cabin monoplane, the prototype of which was designed and built by Cassio Muniz S.A., of São Paulo.

It has been announced that Omareal has developed a new four-seat light aircraft which carries the designation W-141, but no details were available at the time of closing for press.

THE CASMUNIZ 52.

TYPE.—Twin-engined Five-seat Cabin monoplane.

WINGS.—Low-wing cantilever monoplane. Aspect ratio 9.18. Chord 1.80 m. (5 ft. 11 in.) at root, 0.85 m. (2 ft. 9 in.) at tip. Dihedral 6°. Incidence 2° at root, —½° at tip. All-metal structure, with all-metal ailerons and flaps. Total area of ailerons 0.866 m.² (9.32 sq. ft.). Total area of flaps 2.482 m.² (26.72 sq. ft.). Gross wing area 19.26 m.² (207.31 sq. ft.).

FUSELAGE.—All-metal semi-monocoque structure.

TAIL UNIT.—Cantilever monoplane type. All-metal structure. All controls (including aileron controls) are by duralumin tubes supported at joints and articulations by roller bearings. All trim-tabs are positioned electrically by toggle switches on pilot's panel. Areas: fin 0.90 m.² (9.69 sq. ft.), rudder 0.81 m.² (8.72 sq. ft.), elevators 1.806 m.² (19.44 sq. ft.), tailplane 2.27 m.² (24.43 sq. ft.). Tailplane span 4.21 m. (13 ft. 9¼ in.).

LANDING GEAR.—Tail-wheel type with retractable main wheels and non-retractable tail-wheel. Oleo-pneumatic shock-absorbers. Electrical retraction. Goodyear wheels and brakes. Wheel track 3.0 m. (9 ft. 10 in.). Wheelbase 5.287 m. (17 ft. 4 in.).

POWER PLANT.—Two 185 h.p. Continental E185-11 six-cylinder horizontally-opposed air-cooled engines. Hartzell Model HC-12×20-7c two-blade controllable two-position metal airscrews. Fuel in two wing tanks each with a capacity of 160 litres (35.2 Imp. gallons). Total oil capacity 28 litres (6.16 Imp. gallons).

ACCOMMODATION.—Cabin seats pilot and four passengers, with pilot and one passenger in front and three passengers on cross bench at rear of cabin. Dual controls. Entrance door on port side. Controlled ventilation. Baggage compartment behind cabin with outside access door.

DIMENSIONS.—
Span 13.3 m. (43 ft. 8 in.).
Length 8.0 m. (26 ft. 3 in.).
Height 3.5 m. (11 ft. 6 in.).

WEIGHTS.—
Weight empty, including oil 1,280 kg. (2,822 lb.).
Max. payload 375 kg. (827 lb.).
Payload for 4 hr. 20 min. endurance 234 kg. (516 lb.).
Weight loaded 1,750 kg. (3,858 lb.).

PERFORMANCE.—
Max. speed 314 km.h. (195 m.p.h.).
Max. cruising speed 282 km.h. (175 m.p.h.).
Stalling speed (power on, flaps and landing gear down) 96.5 km.h. (60 m.p.h.).
Landing speed 113 km.h. (70 m.p.h.).
Rate of climb at S/L. 460 m./min. (1,500 ft./min.).
Service ceiling 6,100 m. (20,000 ft.).
Take-off distance 200 m. (655 ft.).
Landing distance 300 m. (985 ft.).
Range 1,200 km. (750 miles).



The Casmuniz 52 (two 185 h.p. Continental E185 engines).

THE BRITISH COMMONWEALTH

GREAT BRITAIN

AIRCO

THE AIRCRAFT MANUFACTURING COMPANY LTD.

HEAD OFFICE: GREAT NAST HYDE, HERTFORDSHIRE.

LONDON OFFICE: NORWICH HOUSE, 4, DUNRAVEN STREET, W.1.

Directors: W. E. Nixon, F.C.I.S. (Chairman); Richard Fairey (Deputy Chairman); A. F. Burke, O.B.E., M.Inst. T., F.R.S.A. (Managing); C. P. M. Hunting, T.D., B.A., A.C.A.; A. S. Kennedy, C.A.; F. E. N. St. Barbe; W. A. Summers, C.B.E., F.R.Ae.S., M.I.P.E.

This company was formed in January, 1958, to produce the new D.H. 121 jet airliner which has been ordered in quantity by B.E.A. It had been announced earlier by the British government that this contract would be awarded only on condition that development of the chosen aircraft were privately financed and that the primary manufacture worked in association with other companies to ensure adequate technical and financial resources to complete the project quickly and successfully.

Participation in Airco is in the proportion of The de Havilland Aircraft Co., Ltd., 67½%, Hunting Aircraft Ltd,. 22½% and The Fairey Aviation Co., Ltd., 10%, with respectively four, two and one members on the board of directors.

In naming the new company, the three member firms have revived the name of the company in which the de Havilland group had its origins before and during the 1914-18 war.

Airco has the full support of Rolls-Royce, Ltd., which will undertake development of the power plant of the D.H. 121 as a private venture, and of other leading specialist suppliers.

A description of the D.H. 121 appears in the "de Havilland" entry in this section of "All the World's Aircraft."

ARMSTRONG WHITWORTH

SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT, LTD.

HEAD OFFICE: BAGINTON, NEAR COVENTRY, WARWICKSHIRE.

WORKS: BAGINTON AND WHITLEY, NEAR COVENTRY, AND BITTESWELL, LUTTERWORTH, NEAR RUGBY.

Directors: Sir Frank Spriggs, K.B.E., Hon. F.R.Ae.S. (Chairman); Sir Thomas Sopwith, C.B.E., Hon. F.R.Ae.S.; H. M. Woodhams, C.B.E., F.R.Ae.S., M.I. Prod.E. (Managing Director); Henry R. Watson, B.Sc., A.F.R.Ae.S. (Technical Director); John Lloyd, F.R.Ae.S.; W. S. D. Lockwood, O.B.E., A.F.R.Ae.S., M.I.Prod.E. (Works Director and General Manager); C. S. Emery (Sales Director).

Chief Designer: Edward D. Keen, B.Sc., F.R.Ae.S.

Secretary: F. D. Stallabrass.

Sir W. G. Armstrong Whitworth Aircraft, Ltd. was formed in 1921 and since 1935 has been a member of the Hawker Siddeley Group.

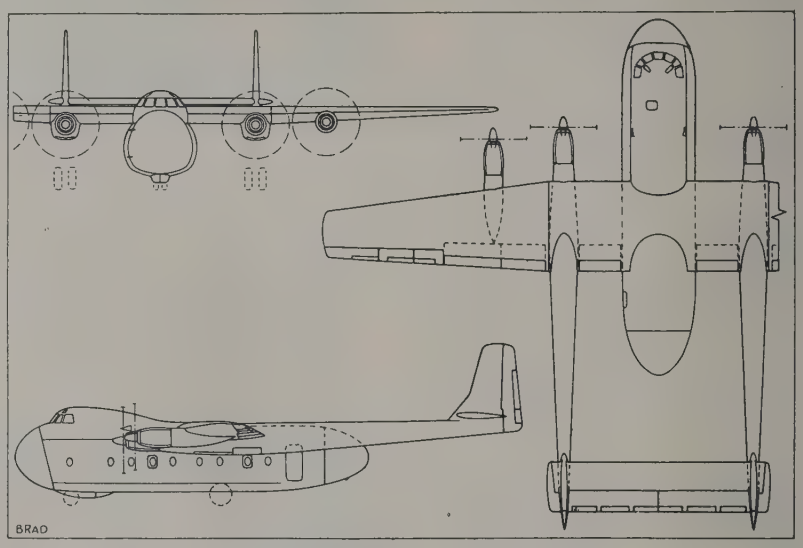
In 1949 Armstrong Whitworth assumed responsibility for the development and production of a two-seat night fighter version of the Gloster Meteor to specification F.24/48 and four successive versions, the Marks 11-14, were developed and produced in quantity for the Royal Air Force. The Meteor night fighter was also supplied to the air forces of Belgium, Denmark and France. A full description of the Meteor two-seat night fighter has appeared in previous editions of "All the World's Aircraft," but brief details are given hereafter of the Meteor T.T. Mk. 20 which has been developed from the N.F. Mk. 11 to meet the requirements of the Royal Navy for a high-speed target-tug.

In 1953 Armstrong Whitworth was entrusted with the development, design and production of the Hawker Sea Hawk. Apart from production for the Royal Navy, Armstrong Whitworth has fulfilled contracts for the supply of Sea Hawks for service in the Dutch and German Navies.

Early in 1957 Armstrong Whitworth announced that it was re-entering the civil aircraft market with the AW.650, a general purpose freight/coach type aircraft powered in its basic form by four Rolls-Royce Dart turboprop engines. Initially, ten AW.650's are being built, the first of which is due to fly in October, 1958.

THE ARMSTRONG WHITWORTH AW650 SERIES.

The AW.650 has been designed specifically to meet the requirements for a large-capacity civil and military passenger and freight transport for worldwide service. A production series of ten of the basic version has been laid down as a private venture and the first of these is due to fly in October, 1958; but the design can be adapted to fulfil a variety of rôles, and the following variants have been offered for subsequent production.



The Armstrong Whitworth AW.650 Argosy

AW.650 Argosy. Basic freighter/coach version now in production. Four Rolls-Royce Dart turboprops. Pressurised.

AW.651. Development of AW.650 with two Rolls-Royce Tyne turboprops. Pressurised.

AW.660. Military transport with ramp-loading and "beaver-tail" rear doors to permit air-drop of freight.

AW.661. Variant of AW.660 with two Rolls-Royce Tynes. Pressurised.

AW.670 Air Ferry. Car ferry version, able to accommodate six cars and 30 passengers on two decks. Fuselage 14 ft. 6 in. (4.42 m.) wide to take two cars abreast. Four Rolls-Royce Darts. Unpressurised.

AW.671 Airbus. High-density "airbus" with accommodation for 96 passengers on lower deck and 30 on upper deck. Wide fuselage as AW.670. Four Rolls-Royce Darts. Unpressurised.

The following details apply to the basic AW.650 version.

TYPE.—Four-engined Passenger and Freight Transport.

WINGS.—Shoulder-wing cantilever monoplane, based on the wing of the Avro Shackleton. Wing section NACA 23018 (modified) at root, NACA 23012 at tip. Aspect ratio 9.07. Mean chord 12 ft. 8.2 in. (3.85 m.). Dihedral 0° on centre section, 2° on outer wings. Incidence 4°. All-metal two-spar structure. All-metal internally-balanced ailerons. All-metal double-slotted flaps. Total area of ailerons 88 sq. ft. (8.17 m.²). Total area of flaps 203 sq. ft. (18.85 m.²). Gross wing area 1,458 sq. ft. (135.4 m.²).

FUSELAGE.—All-metal semi-monocoque structure.

TAIL UNIT.—Cantilever monoplane type, with twin fins and rudders carried on elliptical section metal tail booms. Areas: fins 250 sq. ft. (23.23 m.²), rudders 68 sq. ft. (6.13 m.²), tailplane 327 sq. ft. (30.28 m.²), elevators 111 sq. ft. (9.94 m.²). Tailplane span 38 ft. 6 in. (11.73 m.).

LANDING GEAR.—Retractable tricycle type. Hydraulic retraction. Dowty oleo-pneumatic shock-absorbers. Twin Dunlop wheels on all units. Dunlop Maxaret anti-skid brakes. Wheel track 32 ft. 6 in. (9.90 m.). Wheelbase 25 ft. 5 in. (7.75 m.).

POWER PLANT.—Four Rolls-Royce Dart Mk. 526 turboprop engines, each developing 1,910 h.p. plus 505 lb. (229 kg.) jet thrust for take-off, with maximum continuous power of 1,750 h.p. plus 445 lb. (202 kg.) jet thrust and maximum recommended cruise power of 1,460 h.p. plus 355 lb. (161 kg.) jet thrust. Rotol four-blade airscrews. Fuel in ten bag-type tanks between wing spars, two of 374 Imp. gallons, two of 451 Imp. gallons, two of 405 Imp. gallons, two of 320 Imp. gallons and two of 100 Imp. gallons. Total fuel capacity 3,300 Imp. gallons (15,000 litres).

ACCOMMODATION.—Crew of two or three on raised flight deck above main cabin, which is 46 ft. 8 in. long 11 ft. 8 in. (maximum) wide and 8 ft. 9 in. (maximum) high (14.33 × 3.55 × 2.67 m.). Volume of cabin 3,680 cub. ft. (104.2 m.³). Seats for 83 passengers, or various combinations of passengers and freight, or all freight. Flight deck and main cabin pressurised to differential of 5.5 lb./sq. in. (0.39 kg./cm.²). Full-width loading doors at front and rear of cabin, 6 ft. 8 in. high and 8 ft. 8 in. wide (2.03 × 2.64 m.).

DIMENSIONS.—
Span 115 ft. (35.05 m.).
Length 86 ft. 9 in. (26.44 m.).
Height 27 ft. (8.23 m.).

WEIGHTS.—
Weight empty, equipped 46,000 lb. (20,885 kg.).
Max. payload 28,000 lb. (12,712 kg.).



The Armstrong Whitworth Sea Hawk F. (G.A.) Mk. 6 Naval Fighter Bomber (Rolls-Royce Nene engine).

Payload with max. fuel 9,400 lb. (4,268 kg.).
Weight loaded 82,000 lb. (37,195 kg.).
Wing loading at T.O. weight 56 lb./sq. ft. (273.3 kg./m.²).
Power loading at T.O. weight 9.75 lb./e.h.p. (4.43 kg./e.h.p.).

PERFORMANCE (estimated).—
Max. cruising speed at 25,000 ft. (7,620 m.) 296 m.p.h. (476 km.h.).
Economic cruising speed at 25,000 ft. (7,620 m.) 276 m.p.h. (442 km.h.).
Rate of climb at S/L. 1,400 ft./min. (425 m./min.).
Take-off distance to 50 ft. (15.25 m.) 3,200 ft. (976 m.).
Landing distance from 50 ft. (15.25 m.) 2,920 ft. (890 m.).

RANGES estimated).—
Max. range with 9,400 lb. (6,992 kg.) payload at 25,000 ft. (7,620 m.), 2,800 miles (6,450 km.).
With max. payload (28,000 lb. = 12,712 kg.): 800 miles (1,280 km.).

THE SEA HAWK

The Sea Hawk was designed and the initial production was undertaken by Hawker Aircraft Ltd. The development and production of this aircraft was the responsibility of Sir W. G. Armstrong Whitworth Aircraft Ltd. from mid-1953.

The following versions of the Sea Hawk have been built :—

Sea Hawk F. Mk. 1. Rolls-Royce Nene 101 turbojet engine (5,000 lb.=2,270 kg. s.t.). Spring-tab ailerons. Initial production of Mk. 1 by Hawker Aircraft, Ltd. but transferred to Armstrong Whitworth in 1953.

Sea Hawk F. Mk. 2. Similar to Mk. 1 but with powered ailerons.

Sea Hawk F.R. Mk. 3. Fighter-bomber version of F. Mk. 2. Wings stressed for under-wing stores such as rockets, bombs, etc.

Sea Hawk F. (G.A.) Mk. 4. The Mk. 3 adapted for additional rôle of ground attack.

Sea Hawk F.B. Mk. 5. Similar to Mk. 3, but with up-rated Nene 103 turbojet (5,400 lb.=2,450 kg. s.t.).

Sea Hawk F. (G.A.) Mk. 6. Similar to Mk. 4 but with up-rated Nene 103 turbojet (5,400 lb.=2,450 kg. s.t.).

Sea Hawk Mk. 50. For Royal Netherlands Navy. Differs from Mk. 6 in having American radio equipment. Delivery of 22 completed in 1957.

Sea Hawk Mk. 100. For German Navy. Differs from Mk. 6 in having American radio equipment and provision for carrying four L/R underwing fuel tanks. Also has increased fin and rudder area.

Sea Hawk Mk. 101. For German Navy. As Mk. 100 but with additional electronic equipment. Total of 68 Mk. 100 and Mk. 101 ordered. First three delivered on June 2, 1958.

The description below refers particularly to the Sea Hawk F. (G.A.) Mk. 6.

TYPE.—Single-seat Naval Fighter.

WINGS.—Cantilever mid-wing monoplane. All-metal structure with stressed heavy-gauge skin. Outer wings attached to stub wings by two hinge fittings with automatic locks and a spigot bearing in the leading-edge, and are power-folded. All-metal power-operated ailerons with spring tabs. Combined hydraulically-operated landing and brake flaps of double split type inboard of ailerons. Gross wing area 278 sq. ft. (25.8 m.²). Flap area 50 sq. ft. (4.5 m.²). Aspect ratio 5.5. Dihedral root to tip 4½ degrees. Incidence + ½ degree.

FUSELAGE.—All-metal structure. Nose and centre portions are of semi-monocoque construction reinforced by a box-section keel member and four longerons; the rear portion is a pure monocoque of which the fin base is an integral part. Fuselage is stressed for tail-down accelerated take-offs; single catapult take-off point beneath fuselage.

TAIL UNIT.—All-metal cantilever structure. Tailplane, of one-piece multi-spar construction, passes through fin above fuselage. Controllable trim-tabs in elevators. Total horizontal area 38.6 sq. ft. (3.59 m.²). Total vertical area 33.1 sq. ft. (3.04 m.²).



The Armstrong Whitworth Sea Hawk Mk. 100/101 Naval Fighter (Rolls-Royce Nene engine).

LANDING GEAR.—Retractable tricycle type. Hydraulic retraction. Dowty liquid-spring shock-absorber struts to all wheels. Sting-type arrester hook in rear fuselage. Track 8 ft. 6 in. (2.6 m.).

POWER PLANT.—One Rolls-Royce Nene 103 turbojet engine in centre fuselage. Air intakes in wing leading-edge roots, bifurcated tail-pipe with exits in wing trailing-edge root fairings, one each side of fuselage. Spring-loaded doors in top surface of centre fuselage provide additional air intakes when the engine is ground running and for take-off. As pressure in the plenum chamber increases these doors close automatically. Fuel tanks in fuselage, with provision for under-wing drop tanks.

ACCOMMODATION.—Pilot in pressurised cockpit well forward in nose of fuselage, with three-piece windscreen, including an optically-flat bullet-proof centre section, and single-piece jettisonable canopy. Martin-Baker ejector seat for pilot. Canopy can be jettisoned in conjunction with seat or by itself.

ARMAMENT. Four 20 mm. cannon mounted in lower portion of fuselage nose. Provision for bombs or rocket projectiles on under-wing racks in Mks. 3, 4, 5 and 6.

DIMENSIONS.—
Span 39 ft. (11.9 m.).
Width folded 13 ft. 4 in. (4.04 m.).
Length 39 ft. 7 in. (12.1 m.).
Height 8 ft. 8 in. (2.65 m.).
Height (wing folded) 16 ft. 10 in. (5.1 m.).

WEIGHTS AND PERFORMANCE.—
No data available.

THE METEOR T.T. Mk. 20.

The Meteor T.T. Mk. 20 has been developed from the N.F. Mk. 11 two-seat night fighter to meet the requirements of the Royal Navy for a high-speed target-towing aircraft for shore-based ground-to-air gunnery practice. The basic airframe and power-plant of the N.F. Mk. 11 is retained but all armament and operational equipment has been removed.

The T.T. Mk. 20 carries four sleeve targets, which are described as radar-responsive, in the rear fuselage. They are launched while the aircraft is airborne. An M.L. type "G" fully-feathering windmill winch, mounted on a pylon on the upper surface of the starboard wing, is used for paying out or hauling in the 6,000-foot towing cable.

Near-miss hit-recording gear, together with conductive cable and target microphone, is carried in the targets. The microphone is sensitive to projectile shock-waves and by its use hits and near-misses are detected and signalled *via* the towing cable to an indicator on the control panel in the rear cockpit.

A target exchange unit, which enables a number of targets in succession to be released to earth and new targets to be substituted while airborne, and a cable cutter are fitted. Some re-routing of the rudder and elevator cables has been necessary in the region of the target cannisters, and additional equipment has been installed in the two cockpits.

The removal of the N.F. Mk. 11 armament and other operational items permits the T.T. Mk. 20 with its specialised equipment to operate at weights comparable to those of the standard N.F. Mk. 11. Performance and general flight characteristics with targets stowed are not greatly affected.

AUSTER

AUSTER AIRCRAFT, LTD.

HEAD OFFICE AND WORKS: REARSBY AERODROME, REARSBY, LEICESTER.

Directors: F. Bates (Managing Director), P. Wykes (Chairman), A. J. Pickering, K. Sharp, F. A. Pratley, F.C.A., E. C. Harrison.

Chief Designer: R. E. Bird.

Auster Aircraft, Ltd. was formed in 1939 to manufacture light aircraft and assumed its present title on March 7, 1946. Throughout the last war many military A.O.P. aircraft were built, providing the company with considerable experience in the design of light aircraft to be operated by the Army.

Auster's latest A.O.P. aircraft, the Mk. 9 is in full production. The first Mk. 9 made its first flight on March 19, 1954, and deliveries to the services began on February 11, 1955. Mk. 9's have also been supplied to the Indian Army and the Indian and South African Air Forces.

Auster aircraft in current production include various versions of the Autocar, Aiglet Trainer, Alpha and Alpine civil series, plus the Auster Mk. 9, and the Workmaster and Agricola agricultural aircraft. A complete break-away from conventional Auster types, the Agricola has been designed initially as a top-dressing (aerial fertilizing) aircraft and is in production against orders from Australia and New Zealand. However, it is equally suitable for spraying, dusting, aerial baiting, fence dropping and aerial seeding. In addition, the new four-seat Atlantic is under development.

Most three- or four-seat civil Austers can be fitted with equipment for crop-dusting and spraying, cable-laying, glider-towing, banner-towing, aerial advertising, air-to-ground broadcasting, aerial photography and air ambulance duties. Skis and cross-wind landing wheels are also approved for fitment to Austers, and those types with engines of 130 h.p. or more can be fitted with floats. All three-seaters can have a double rear seat fitted to convert them into occasional four seaters.

THE AUSTER Mk. 9.

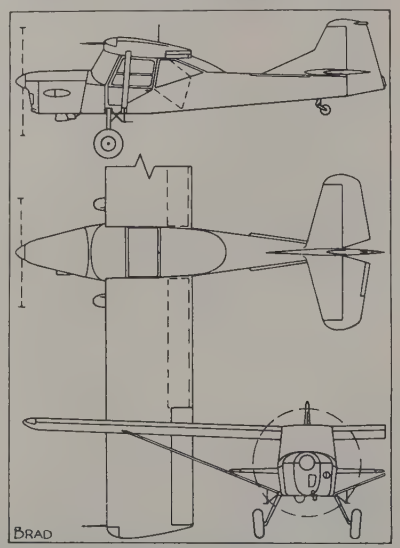
TYPE.—Two/three-seat Air Observation Post and Light Communications monoplane.

WINGS.—High-wing braced monoplane. NACA 23012 wing section. Chord 5 ft. 6 in. (1.67 m.). Dihedral 2°. Structure comprises one built-up metal I-type main spar, pressed metal nose ribs, tubular leading-edge and pre-formed sheet metal D-section skin to form torsion box; and, aft of spar, pressed light alloy ribs covered with fabric. Moulded Durestos wing-tips. Each wing braced to fuselage by single extruded light alloy strut. Metal-framed, fabric-covered slotted ailerons droop automatically when split flaps are lowered. Maximum aileron droop 10°. Flap settings 22° for take-off, 50° for landing. Gross wing area 197.6 sq. ft. (18.36 m.²).

FUSELAGE.—Warren-type welded steel tube structure covered with fabric aft of front door hinge post.

TAIL UNIT.—Cantilever monoplane type. Stressed skin construction, the skins of all surfaces being reinforced by Redux-ed internal chordwise stiffeners. Moulded Durestos tip to rudder forms horn balance. Ground-adjustable tab in rudder, controllable trim-tab in port elevator.

LANDING GEAR.—Fixed tail-wheel type. Single forged legs pivoted near upper ends and sprung by Dowty liquid-spring shock absorbers mounted horizontally within box-section extruded shock truss extending across fuselage between landing-gear pick-up points. Goodyear wheels, low-pressure tyres and toe-operated hydraulically-operated single-disc brakes. Fully-castoring levered-suspension tail-wheel unit with Dowty liquid-sprung shock-absorber. Track: 6 ft. 8 in. (2.0 m.).



The Auster Mk. 9.

POWER PLANT.—One Cirrus Bombardier 203 four-cylinder in-line inverted air-cooled engine rated at 173 h.p. on M.T. fuel. Plessey cartridge type starter. Fairey-Reed fixed-pitch metal airscrew, diameter 7 ft. (2.1 m.). Main fuel in Marston Excelsior bag-type tank in starboard wing root. Normal fuel capacity 15 Imp. gallons (68 litres). For longer range corresponding tank may be fitted in port wing root, and for ferrying an auxiliary tank can be installed in rear fuselage.

ACCOMMODATION.—Seating for three in enclosed cabin. Pilot and passenger side-by-side. Observer at rear may face forward or aft. One door on port side, two on starboard side, all fitted with jettison gear. Detachable rear cabin floor permits quick conversion to other rôles, such as vertical air photography.

EQUIPMENT.—Four 4-in. flares can be carried on standard light bomb carrier under fuselage for flare-dropping duties.

DIMENSIONS.—
Span 36 ft. 5 in. (11.22 m.).
Length 23 ft. 8½ in. (7.23 m.).
Height (on ground) 8 ft. 11 in. (2.7 m.).

WEIGHTS AND LOADINGS.—
Weight empty 1,590 lb. (720 kg.).
Weight loaded (normal A.O.P. operational load including pilot, observer, two radios, full fuel load, etc) 2,125 lb. (974 kg.).
Overload max. weight 2,330 lb. (1,057 kg.).
Wing loading 10.4 lb./sq. ft. (50.75 kg./m.²).
Power loading 11.9 lb./h.p. (5.39 kg./h.p.).

PERFORMANCE (at 2,125 lb. = 974 kg. A.U.W.).
Max. speed 127 m.p.h. (204 km.h.).
Normal cruising speed 110 m.p.h. (178 km.h.).
Initial rate of climb 970 ft./min. (296 m./min.).
Absolute ceiling 19,500 ft. (5,950 m.).
Range at economic cruise 242 miles (400 km.).



The Auster Mk. 9 (173 h.p. Cirrus Bombardier engine).



The Auster Agricola (240 h.p. Continental O-470 engine).

Take-off run in 6 m.p.h. (9.3 km.h.) wind 100 yds. (91 m.).
Take-off to clear 50 ft. (15.25) m. in 6 m.p.h. (9.3 km.h.) wind 225 yds. (206 m.).
Landing run in 6 m.p.h. (9.3 km.h.) wind 50 yds. (46 m.).
Landing distance from 50 ft. (15.25 m.) in 6 m.p.h. (9.3 km.) wind 200 yds. (183 m.).

THE AUSTER B.8 AGRICOLA

TYPE.—Single-engined Agricultural monoplane.

WINGS.—Low-wing cantilever monoplane. Centre section aerofoil NACA 43018. Outer wing airofoil at tip NACA 23012. Chord 7 ft. (2.13 m.) at root, 4 ft. 3½ in. (1.30 m.) at tip. Dihedral 7° on outer wings. Metal two-spar structure, with metal covered leading-edge which forms a torsion box on outer wings. Fabric-covering aft of front spar, except for small portion at root of outer wings which is metal-covered to withstand drag loads. Slotted ailerons have metal structure with fabric-covering. Double split flaps have metal structure and metal covering, and are hydraulically operated. Gross wing area 254.7 sq. ft. (23.68 m.²).

FUSELAGE.—Welded steel tube structure, fabric-covered aft of hopper filling trunk.

TAIL UNIT.—Cantilever monoplane type. All metal structure with fabric covering. Ground adjustable trim-tab on rudder. Controllable trim-tab on port elevator. Area of tailplane and elevator 45.01 sq. ft. (4.18 m.²). Tailplane span 14 ft. 1½ in. (4.31 m.).

LANDING GEAR.—Fixed tail-wheel type. Interchangeable Electro-Hydraulics main wheel oleo units specially designed to withstand continuous rough landings. Goodyear wheels, tyres and disc brakes. Tyres 8.50-6. Oleo-type tailwheel, with 10 in. (25.4 cm.) tyre. Wheel track 14 ft. 4 in. (4.37 m.). Wheelbase 19 ft. (5.79 m.).

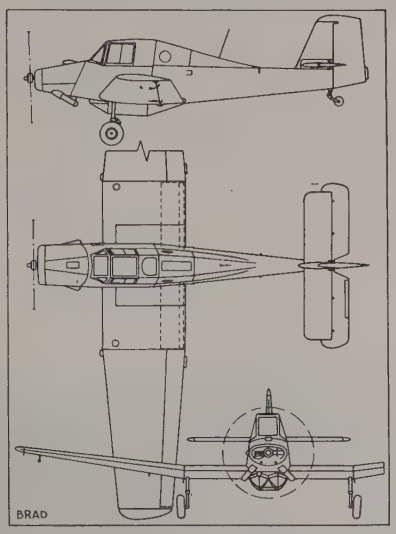
POWER PLANT.—One 240 h.p. Continental O-470-M2 six-cylinder horizontally-opposed air-cooled engine, driving a two-blade constant-speed McCauley Met-L-Matic 2A36C1-4 airscrew, diameter 7 ft. 2 in. (2.18 m.). Crash-proof fuel tank with 24 Imp. gallons (109 litres) capacity in port wing root. Oil capacity 2.5 Imp. gallons (11.4 litres).

ACCOMMODATION.—Enclosed single-seat cabin for pilot situated well forward for good visibility. Side-by-side two-seat cabin just aft of hopper trunk with rearward facing bench-type seat. Hopper for 1,680 lb. (762 kg.) dust below pilot with two pairs of hydraulically-operated doors permitting emergency dumping of load in only 5 seconds. Spray tanks in centre-section have total capacity of 144 Imp. gallons (654 litres). Spray booms inside wings with only nozzles projecting.

DIMENSIONS.—
Span 42 ft. (12.80 m.).
Length 28 ft. 1 in. (8.56 m.).
Height 8 ft. 4 in. (2.53 m.).

WEIGHTS.—
Weight loaded with 1,400 lb. (635 kg.) payload 3,675 lb. (1,663 kg.).
Weight loaded with 1,680 lb. (762 kg.) payload 3,810 lb. (1,728 kg.).

PERFORMANCE (at 3,675 lb.=1,663 kg. A.U.W.).—
Max. speed at 1,000 ft. (305 m.) 127 m.p.h. (204 km.h.).
Max. cruising speed at 1,000 ft. (305 m.) 123 m.p.h. (198 km.h.).
Normal cruising speed 111 m.p.h. (179 km.h.).
Economical cruising speed at 1,000 ft. (305 m.) 101 m.p.h. (163 km.h.).
Stalling speed (flaps down) 44 m.p.h. (71 km.h.).



The Auster Agricola.

Rate of climb at S/L 610 ft./min. (186 m./min.).
Service ceiling 10,500 ft. (3,200 m.).
Take-off run in 6 m.p.h. (9.3 km.h.) wind 555 ft. (169 m.).
Take-off distance to clear 20 ft. (6 m.) in 6 m.p.h. (9.3 km.h.) wind 1,095 ft. (333 m.).
Landing run 435 ft. (132 m.).
Landing distance from 20 ft. (6 m.) in 6 m.p.h. (9.3 km.h.) wind 945 ft. (290 m.).
Max. range 218 miles (350 km.).

THE AUSTER J/1U WORKMASTER.

Evolved especially to meet the requirements of Crop Culture Ltd. for a new agricultural aircraft, the first Workmaster flew on February 22, 1958, only 53 days after design drawings were released to the production shop. It is now in production, initial orders for 14 Workmasters having been received from Crop Culture Ltd. and their French associate, Ardic.

A special feature of the Workmaster is provision of a passenger seat behind the pilot, in addition to the 100 Imp. gallon (455 litre) spray-tank alongside the pilot's seat. Safety features include a thick bird-resistant windscreen, emergency jettison system for the spray, oversize low-pressure tyres for safe taxying on rough airstrips and strengthened pilot's seat.

TYPE.—Two-seat Agricultural monoplane.

WINGS.— High-wing braced monoplane. NACA 23012 wing section. Aspect ratio 7. Chord 5 ft. 3 in. (1.60 m.). Dihedral 1°. Incidence 3¾° at root, 2½° at tip. Wooden spars, light alloy ribs. Metal leading-edge skin, with an overall fabric covering. Streamlined steel-tube V bracing struts each side. Wooden ailerons with metal leading-edge skin and fabric-covering. All-metal manually-operated split trailing-edge flaps. Total area of ailerons 20 sq. ft. (1.86 m.²). Total area of flaps 16 sq. ft. (1.49 m.²). Gross wing area 185 sq. ft. (17.14 m.²).

FUSELAGE.—Rectangular-section welded steel-tube structure with fabric covering.

TAIL UNIT.—Braced monoplane type. Welded steel structure with fabric covering. Trim-tab in rudder adjustable on ground. Controllable trim-tab in port elevator. External tie-rod bracing. Areas: horizontal tail surfaces 24.7 sq. ft. (2.3 m.²), fin 5.1 sq. ft. (0.47 m.²), rudder 10.1 sq. ft. (0.94 m.²). Tailplane span 10 ft. (3.05 m.).

LANDING GEAR.—Non-retractable tail-wheel type. Oversize low-pressure tyres. Goodyear hydraulic disc brakes. Fully-castoring tail-wheel with 8 in. (20 cm.) tyre, on strengthened tail-spring. Wheel track 6 ft. 2 in. (1.88 m.). Wheelbase 19 ft. 4 in. (5.90 m.).

POWER PLANT.—One 180 h.p. Lycoming O-360-A four-cylinder horizontally-opposed air-cooled engine, driving a two-blade McCauley variable-pitch airscrew. Cross-over exhaust system for maximum power at take-off. Two fuel tanks, one in each wing root, with total capacity of 32 Imp. gallons (145 litres).

ACCOMMODATION.—Enclosed cabin seating two in tandem. Spray tank with capacity of 100 Imp. gallons on starboard side of cabin. Pilot's seat strengthened to withstand 25g. loading. Shoulder harness.

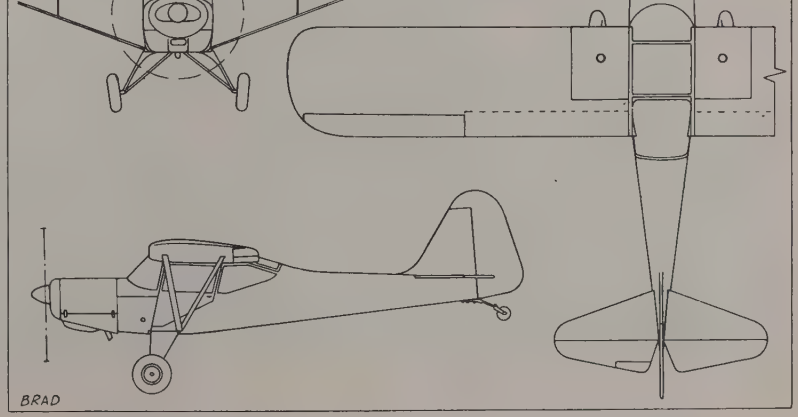
DIMENSIONS.—
Span 36 ft. (11.0 m.).
Length 23 ft. 7 in. (7.18 m.).
Height 6 ft. 2 in. (1.88 m.).

WEIGHT.—
Weight loaded 2,550 lb. (1,157 kg.).

PERFORMANCE.—
Max. speed 104 m.p.h. (167 km.h.).
Economical cruising speed (66% power) 88 m.p.h. (142 km.h.).
Max. spraying speed 90 m.p.h. (145 km.h.).
Initial rate of climb 650 ft./min. (200 m./min.).
Take-off run 540 ft. (165 m.).

THE AUSTER ATLANTIC.

The Atlantic is a completely new design, with a tricycle landing gear and equipped and furnished to a much higher



The Auster J/1U Workmaster (180 h.p. Lycoming O-360A engine).



The Auster J1N Alpha (130 h.p. D.H. Gipsy Major engine).

standard than any previous Auster type. Intended for private owner or business "executive" use, it is a four-seater, powered by a 205 h.p. Continental E185-10 six-cylinder horizontally-opposed air-cooled engine.

The cabin is sound-proofed, air-conditioned and fully-upholstered, with carpet on the floor. Key-type ignition, glove compartments, ash-trays, tailored travel cases and cigar lighter are standard, with provision for extensive radio and blind-flying instruments. Equipment includes flaps, hydraulic wheel-brakes, wheel spats, parking brake, steerable nose-wheel, metal variable-pitch airscrew and dual controls.

Two versions of the Atlantic are under development :—

Windsor de luxe. Fully-equipped standard version, as described above. Prototype, scheduled to fly in 1958, is of this type.

Winchester. Basically as Windsor de luxe, but less extensively equipped and without radio and blind-flying instruments.

PERFORMANCE (estimated).—
Cruising speed up to 135 m.p.h. (217 km.h.).
Landing speed 50-55 m.p.h. (80-89 km.h.).
Rate of climb at S/L 800-1,150 ft./min. (245-350 m./min.).
Take-off distance, zero wind, 135-225 yards (123-206 m.).
Landing distance, zero wind, 130 yards (119 m.).
Range at 124 m.p.h. (200 km.h.) with 610 lb. (277 kg.) payload 440 miles (710 km.).

THE AUSTER ALPHA.

The Alpha has been produced to meet the need for a really low-price light aircraft capable of a variety of duties in varied climatic conditions. It is available in two versions :—

J/1N Alpha. With 130 h.p. de Havilland Gipsy Major 1 engine. First flew July 1, 1955.

Alpha 5. With 130 h.p. Lycoming O-290-3/1 engine.

Both versions are being delivered as completely new aircraft by the manufacturers ; but many owners of Auster J1 Autocrats are also bringing their aircraft virtually to J1N Alpha standard by fitting the more powerful Gipsy Major engine and a new tail unit with horn balanced rudder.

There are two individual front seats, with dual controls as standard equipment, and a bench-type rear seat for one adult or two children. Optional equipment includes a light stretcher unit, fittings for crop-spraying or air photography and, in the Lycoming-engined version, fittings for glider and banner towing. The wheels can be exchanged for skis or floats, and the Lycoming-powered floatplane is able to carry a full load of three persons and 15 Imp. gallons (68 litres) of fuel.

PERFORMANCE (either engine, with 2 persons and 15 Imp. gallons = 68 litres fuel).—
Max. cruising speed 108 m.p.h. (174 km.h.).



The Auster Alpha 5 (130 h.p. Lycoming O-290 engine).

Rate of climb at S/L. 950 ft./min. (290 m./min.).
Take-off run in 5 m.p.h. (8 km.h.) wind under 300 ft. (91 m.).
Take-off distance to 50 ft. (15.25 m.) in 5 m.p.h. (8 km.h.) wind 675 ft. (206 m.).
Landing run in 5 m.p.h. (8 km.h.) wind 315 ft. (96 m.).
Landing distance from 50 ft. (15.25 m.) in 5 m.p.h. (8 km.h.) wind 900 ft. (275 m.).

THE AUSTER AIGLET TRAINER.

The Aiglet Trainer is a two-seat dual-control aerobatic training aircraft which has been designed to fulfil present-day training requirements and to provide maximum usage at lowest cost. The airframe is basically similar to the earlier J.5, but the Aiglet Trainer has horn-balanced rudder and elevators and the wings have been clipped by 4 ft. (1.22 m.) to give a greater rate of roll. The side-by-side seats are designed to conform to the aircraft's aerobatic category and the fuselage width has been increased by 4 in. (10.16 cm.) to give a wider cabin than usual in Auster types.

Two versions of the Aiglet Trainer have been produced :

J.5F. 130 h.p. D.H. Gipsy Major I engine. Standard version, described below.

J.FL. 145 h.p. D.H. Gipsy Major 10/2 engine. Two/three-seat trainer. Fifteen for Iranian Government. Delivery began in July, 1958.

The J.5F can also be supplied as a three-seat tourer, in which case the aerobatic seats are replaced by standard Auster front seats. The seat for the rear passenger is of the wide forward-facing type.

TYPE.—Two-seat Aerobatic Trainer or three-seat Touring monoplane.

WINGS.—Strut-braced high-wing monoplane. Incidence (root) 3¾ degrees, (tip) 2½ degrees ; dihedral 1 degree ; chord 5 ft. 3 in. (1.60 m.). Wing braced by streamlined steel-tube V-struts on each side. Structure consists of laminated spruce spars, ribs of drawn-section light alloy, steel drag struts and tie-rod internal bracing, metal leading-edge and an overall fabric covering. Ailerons have wooden spars, light alloy nose and ribs and fabric covering. Manually-operated split trailing-edge flaps have steel torsion shaft and light alloy skin. Gross wing area 164 sq. ft. (15.24 m.²).

FUSELAGE.—Rectangular-section welded steel-tube structure with fabric covering.

TAIL UNIT.—Braced monoplane type. Welded steel-tube framework with fabric covering. Fixed tailplane. Horn-balanced rudder and elevators. Rudder has trim-tab adjustable on ground. Controllable trim-tab in port elevator. External tie-rod bracing. Tailplane span 10 ft. (3.05 m.).

LANDING GEAR.—Fixed tail-wheel type. Half-axles sprung under centre-line of fuselage with rubber-cord shock-absorbers. Dunlop wheels and Bendix brakes. Track 6 ft. 0 in. (1.83 m.). Full-castoring tail-wheel on leaf-spring with solid rubber tyre.

POWER PLANT.—One 130 h.p. D.H. Gipsy Major 1 four-cylinder in-line inverted air-cooled engine. Fairey-Reed metal airscrew. Fuel tank with 16 Imp. gallon (72.5 litre) capacity in starboard wing root. Provision for similar tank in port wing for long-range flying.

ACCOMMODATION.—Enclosed cabin seating two side-by-side with dual controls, with seat for third person in rear of cabin when aircraft is used for touring. One-piece moulded Perspex wind-shield and moulded cabin roof. Access door on each side with sliding windows.

DIMENSIONS.—
Span 32 ft. (9.76 m.).
Length 23 ft. 2¾ in. (7.07 m.).
Height 8 ft. 3 in. (2.52 m.).

WEIGHTS AND LOADINGS.—
Weight empty 1,323 lb. (601 kg.).
Weight loaded (Aerobatic two-seater) 1,950 lb. (885 kg.).
Weight loaded (three-seat Tourer) 2,200 lb. (1,000 kg.).
Wing loading 13.45 lb./sq. ft. (65.63 kg./m.²).



The Auster Aiglet Trainer (130 h.p. D.H. Gipsy Major I engine).

Power loading 16.9 lb./h.p. (7.67 kg./h.p.).

PERFORMANCE.—
Max. speed 127 m.p.h. (203 km.h.).
Cruising speed 110 m.p.h. (176 km.h.).
Stalling speed (engine off, full flap) 29 m.p.h. (46.4 km.h.).
Initial rate of climb 705 ft./min. (215 m./min.).
Take-off run (still air) 172 yds. (157 m.).
Cruising range (one tank) 275 miles (440 km.).
Max. cruising range (two tanks) 545 miles (872 km.).

THE AUSTER AUTOCAR.

The four-seat Autocar is the most versatile of the Auster civil types, and can be used for freighting, spraying, dusting, glider towing and ambulance duties, as well as passenger-carrying.

It has tail surfaces of greater area than earlier Auster designs, with horn-balanced rudder. In addition, its cabin is deeper, with a characteristic "hump" in side elevation.

There are three versions, the J5B (named Autocar) with 130 h.p. Gipsy Major 1 engine; the J5G (named Cirrus Autocar) with Cirrus Major 3 engine; and the J5P (named Autocar 145) with Gipsy Major 10 engine.

TYPE.—Four-seat Cabin monoplane.

WINGS.—High-wing strut-braced monoplane. Incidence (root) 3¼°, (tip) 2¼°. Dihedral 1°. Chord 5 ft. 3 in. (1.60 m.). Wing braced by streamlined steel-tube V-struts on each side. Structure consists of laminated spruce spars, ribs of drawn-section light alloy, steel drag struts and tie-rod internal bracing, metal leading-edge with an overall fabric covering. Ailerons have wooden spars, light alloy nose and ribs with fabric covering. Manually-operated split trailing-edge flaps have steel torsion shaft and light alloy skin. Total aileron area 18 sq. ft. (1.66 m.²). Total flap area 16 sq. ft. (1.47 m.²). Gross wing area 185 sq. ft. (17.14 m.²).

FUSELAGE.—Rectangular section welded steel tube structure with fabric covering.

TAIL UNIT.—Braced monoplane type. Welded steel framework with fabric covering. Fixed tailplane. Rudder has trim-tab, adjustable on the ground and is horn-balanced. Controllable trim-tab in port elevator. External tie-rod bracing. Tailplane span 10 ft. (3.05 m.). Gross tailplane area 24.72 sq. ft. (2.28 m.²). Fin area 5.1 sq. ft. (0.47 m.²). Rudder area 10.1 sq. ft. (0.93 m.²).

LANDING GEAR.—Fixed tail-wheel type. Half-axles sprung under centre-line of fuselage with rubber-cord shock-absorbers. Dunlop wheels and Bendix brakes. Track 6 ft. 0 in. (1.83 m.). Full-castoring tail-wheel on leaf-spring with solid conductive rubber tyre.

POWER PLANT.—One 130 h.p. Gipsy Major 1 (J.5B) or 155 h.p. Cirrus Major 3 (J.5G) or 145 h.p. Gipsy Major 10 (J.5P) four-cylinder in-line inverted air-cooled engine. Silencer and metal Fairey-Reed airscrew are standard. Fuel tanks in each wing root, total capacity 32 Imp. gallons (145 litres). Oil tank, capacity 3 gallons (13.6 litres) aft of engine.

ACCOMMODATION.—Enclosed cabin seating two side-by-side, with dual controls if required, and two side-by-side at rear of cabin. Backs of front seats hinge forward for access to rear. Luggage space aft of rear seat. One access door in each side with sliding windows.

DIMENSIONS.—
Span 36 ft. 0 in. (11.0 m.).
Length 23 ft. 2 in. (7.1 m.).
Height 7 ft. 6 in. (2.3 m.)

WEIGHTS AND LOADINGS (J.5B Gipsy Major I engine).—
Weight empty 1,413 lb. (640 kg.).
Weight loaded 2,400 lb. (1,089 kg.).
Wing loading 13 lb./sq. ft. (63 kg./m.²).
Power loading 18.5 lb./h.p. (8.25 kg./h.p.).

WEIGHTS AND LOADINGS (J.5G Cirrus Major 3 engine).—
Weight empty 1,367 lb. (621 kg.).
Weight loaded 2,450 lb. (1,112 kg.).
Wing loading 13.3 lb./sq. ft. (64.9 kg./m.²).
Power loading 15.8 lb./h.p. (7.17 kg./h.p.).

WEIGHTS AND LOADINGS (J.5P Gipsy Major 10 engine).
Max. weight loaded 2,450 lb. (1,111 kg.).
Power loading 16.9 lb./h.p. (7.55 kg./h.p.).
Wing loading 13.3 lb./sq. ft. (65 kg./m.²).

PERFORMANCE (J.5B Gipsy Major I engine).—
Max. speed 116 m.p.h. (186 km.h.).
Cruising speed 100 m.p.h. (160 km.h.).
Stalling speed (flaps down) 34 m.p.h. (55 km.h.).
Stalling speed (flaps up) 42 m.p.h. (67.6 km.h.).
Rate of climb 525 ft./min. (2.66 m./sec.).
Service ceiling 11,000 ft. (2,352 m.).
Absolute ceiling 13,000 ft. (3,962 m.).
Still air range 500 miles (805 km.).
Take-off run (5 m.p.h.=8 km.h. wind) 211 yds. (192 m.).
Take-off distance to 50 ft. (15.2 m.) 537 yds. (490 m.).
Landing run (5 m.p.h.=8 km.h. wind) 163 yds. (159 m.).

PERFORMANCE (J.5G Cirrus Major 3 engine).—
Max. speed 127 m.p.h. (203 km.h.).
Cruising speed 110 m.p.h. (176 km.h.).
Stalling speed (flaps down) 36 m.p.h. (57.6 km.h.).
Initial rate of climb 710 ft./min. (216.5 m./min.).
Service ceiling 14,000 ft. (4,270 m.).
Absolute ceiling 16,200 ft. (4,940 m.).
Still air range 485 miles (775 km.).
Take-off run (5 m.p.h.=8 km.h. wind) 175 yds. (160 m.).
Take-off distance to 50 ft. (15.2 m.) 320 yds. (293 m.).
Landing run (5 m.p.h.=8 km.h. wind) 130 yds. (120 m.).

PERFORMANCE (J.5P Gipsy Major 10 engine).—
Max. speed 125 m.p.h. (201 km.h.).
Cruising speed 111 m.p.h. (185 km.h.).
Stalling speed (flaps down) 36 m.p.h. (58 km.h.).
Stalling speed (flaps up) 45 m.p.h. (72.4 km.h.).
Landing speed 55 m.p.h. (89 km.h.).
Rate of climb at S/L. 620 ft./min. (189 m./min.).
Service ceiling 13,500 ft. (4,110 m.).
Absolute ceiling 16,000 ft. (4,880 m.).
Take-off run (5 m.p.h.=8 km.h. wind) 245 yards (224 m.).
Landing run (5 m.p.h.=8 km.h. wind) 130 yards (119 m.).
Range (still air) 425 miles (685 km.).

PERFORMANCE (J.5P Gipsy Major 10, as float-plane, A.U.W. 2,400 lb.=1,085 kg.).—
Rate of climb at S/L. 480 ft./min. (146 m./min.).
Take-off time to unstick 44 seconds.
Take-off distance to unstick 660 yards (602 m.).
Range (still air) 181 miles (297 km.).



The Auster Alpine (145 h.p. D.H. Gipsy Major 10 engine).

THE AUSTER ALPINE.

This civil Auster incorporates features of both the Autocar and Aiglet. Basically, it combines the wide cabin of the Aiglet Trainer with long-span Autocar wings.

TYPE.—Three-seat Cabin monoplane.

WINGS.—High wing strut-braced monoplane. Steel tube Vee bracing struts. Structure, etc. as for Autocar.

FUSELAGE.—Welded steel tube structure covered with fabric. Same as for Aiglet Trainer.

TAIL UNIT.—Similar to J.5G Autocar, with horn-balanced elevator. Span of tailplane and elevator increased to 11 ft. 5 in. (3.48 m.).

LANDING GEAR.—Fixed tail-wheel type as on Autocar.

POWER PLANT.—One 145 h.p. D.H. Gipsy Major 10 or 130 h.p. D.H. Gipsy Major 1 four-cylinder in-line inverted air-cooled engine. Silencer and metal airscrew fitted as standard. Fuel in two tanks in wing roots, each with capacity of 16 Imp. gallons (72.5 litres).

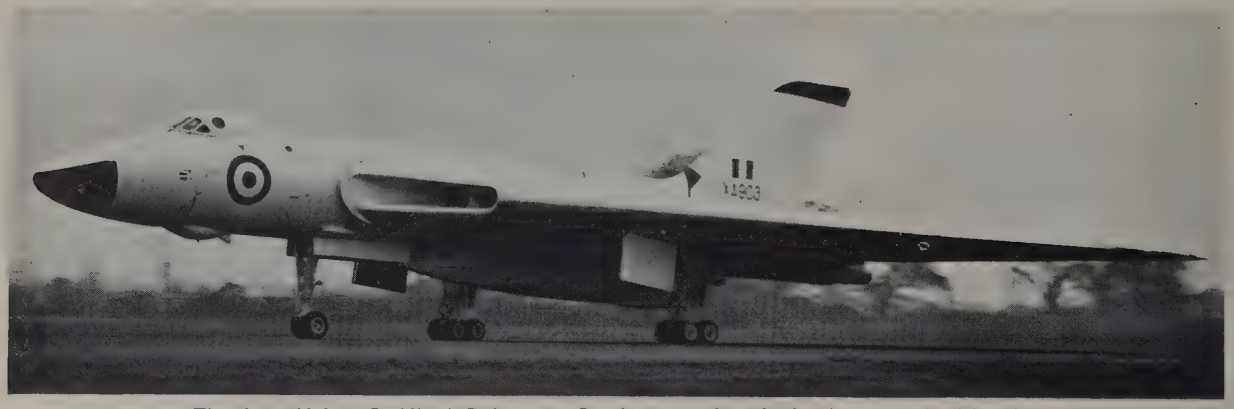
ACCOMMODATION.—Enclosed cabin seating three persons. Dual controls and brakes provided for side-by-side front seats. Luggage space aft of rear seat.

DIMENSIONS.—
Span 36 ft. (11.0 m.).
Length 23 ft. 2 in. (7.1 m.).
Height 7 ft. 6 in. (2.3 m.).

PERFORMANCE (A.U.W. 1,827 lb.=829 kg.=two persons and 16 Imp. gallons=72.5 litres fuel).
Max. speed at 4,000 ft. (1,220 m.) 124 m.p.h. (200 km.h.).
Max. cruising speed at 4,000 ft. (1,220 m.) 110 m.p.h. (177 km.h.).
Stalling speed 31 m.p.h. (50 km.h.).
Rate of climb at S/L. 1,025 ft./min. (313 m./min.).
Ceiling 22,000 ft. (6,705 m.).
Take-off run in 5 m.p.h. (8 km.h.) wind 270 ft. (82 m.).
Take-off distance to clear 50 ft. (15.25 m.) in 5 m.p.h. (8 km.h.) wind 630 ft. (192 m.).
Max. range (still air) at 101 m.p.h. (163 km.h.) 460 miles (740 km.).
Landing run 300 ft. (92 m.).



An Auster Autocar Seaplane (130 h.p. D.H. Gipsy Major I engine).



The Avro Vulcan B. Mk. I Delta-wing Bomber armed with the Avro stand-off bomb.

A. V. ROE & CO., LTD.

HEAD OFFICE: GREENGATE, MIDDLETON, MANCHESTER.

LONDON OFFICE: 18, ST. JAMES'S SQUARE, W.1.

Directors: Sir Frank Spriggs, K.B.E., Hon. F.R.Ae.S. (Chairman); Sir Thomas Sopwith, C.B.E., Hon. F.R.Ae.S.; Sir Roy H. Dobson, C.B.E., F.R.Ae.S. (Managing Director); Sir William Farren, C.B., M.B.E., M.A., F.R.S., M.I.Mech.E., F.R.Ae.S. (Technical Director); C. E. Fielding, O.B.E., F.R.Ae.S., M.I.P.E. (Production); S. G. Joy (Secretary and Director); J. A. R. Kay, A.F.R.Ae.S. (General Manager); and J. Green, O.B.E. (Controller-General, Engineering).

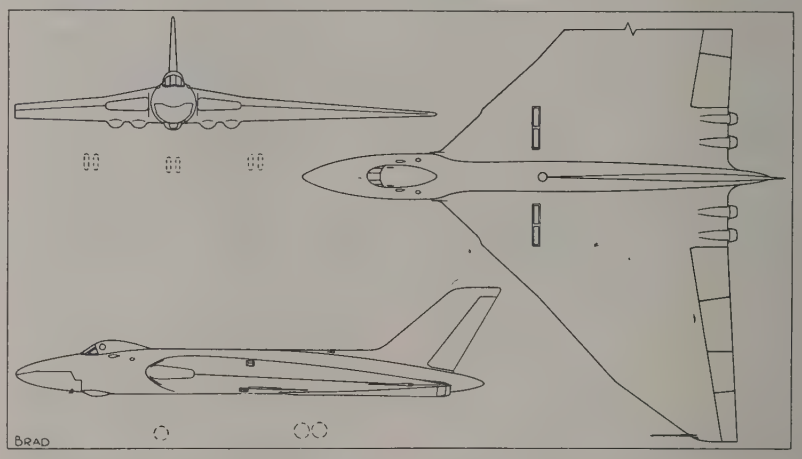
Chief Designer: J. R. Ewans, A.C.G.I., B.Sc., D.I.C., A.F.R.Ae.S.

A. V. Roe & Co. was formed in 1910, when the firm advertised itself as constructors of aeroplanes and accessories, and was probably the first firm in Great Britain to do so. The limited company was formed in January, 1913. On the amalgamation of the Hawker and Siddeley interests in 1935, the Avro Company, which formerly was a member of the Siddeley group, became a member of the group of companies controlled by the Hawker Siddeley Group.

In 1947 the Avro company embarked on an extensive progamme of delta-wing research, following its decision to meet an official specification for a long-range medium bomber with an aircraft of that configuration. A series of small jet-powered delta-wing aircraft, roughly one-third the size of the proposed Type 698 bomber, were built for low-speed research (Types 707 and 707B), high-speed research (Type 707A) and flight familiarisation (Type 707C). The first 707 made its first flight on September 4, 1949, followed by the 707B on September 6, 1950, two 707A's in June, 1951, and February, 1953, respectively, and the two-seat 707C on July 1, 1953.

Of the four Type 707 research aircraft, one of them is still flying in Australia under the ægis of the Department of Supply, to which it has been loaned by the British Ministry of Supply, for boundary layer control experiments.

The Type 698 Vulcan is in production for the Royal Air Force and at the time of writing three squadrons of Bomber Command were fully equipped with Vulcans. Also in production is the Shackleton four-engined maritime reconnaissance aircraft. The Shackleton is in operational service with R.A.F. Coastal Command and has also been supplied to the South African Air Force.



The Avro Vulcan B. Mk. I Delta-wing Bomber.



The Avro Vulcan B. Mk. I Delta-wing Bomber (four Bristol Olympus 100 Series engines).

Avro are also engaged on the development of guided weapons, including a powered "stand-off" bomb which will be carried by the R.A.F.'s Vulcan and Victor bombers. To facilitate this work, the company has a weapons Research Establishment at Salisbury, South Australia, near the Woomera rocket range.

THE AVRO TYPE 698 VULCAN.

The Vulcan, the first jet bomber to employ the delta wing configuration, is the result of extensive research work with the Avro 707A and 707B.

The first prototype Vulcan (VX770) powered by four Rolls-Royce Avon turbojet engines, flew for the first time on August 30, 1952, but this aircraft was later fitted with four Armstrong Siddeley Sapphire engines. A second prototype (VX777) powered by four Bristol Olympus turbojet engines made its initial flight on September 3, 1953. This second prototype was later provided with wings having a re-designed leading-edge with compound sweepback, and in this form it made its first flight on October 5, 1955.

All production Mk. 1 Vulcans are fitted with wings having the new leading-edge configuration. Two versions of the Vulcan have been announced :—

Vulcan B. Mk. 1. First production version with four Bristol Olympus 100 Series turbojets. First B. Mk. 1 (XA 889) flew on February 4, 1955. Crew of five.

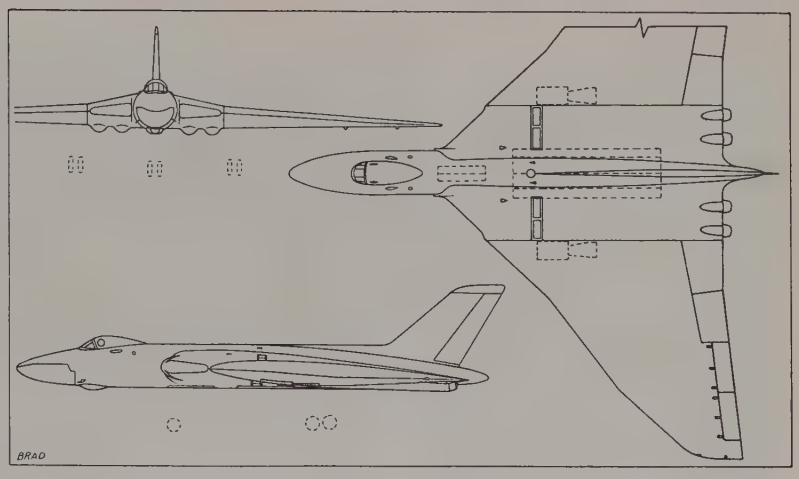
Vulcan B. Mk. 2. Developed version to have 16,000 lb. (7,257 kg.) s.t. Bristol Olympus 200 Series turbojets and wing of increased span, with elevon controls. Aerodynamic prototype of the Mk. 2 (modified second Vulcan prototype VX777) flew for the first time on August 31, 1957. First production Mk. 2 (XH533) flew in August, 1958.

The original prototype Vulcan (VX770) was fitted experimentally with four Rolls-Royce Conway turbojets, and made its first flight in this form on August 9, 1957. This aircraft was being used by Rolls-Royce as a flying test-bed for the Conway engine. It was destroyed in an accident on September 20, 1958.

The following details apply specifically to the Vulcan B.Mk.1, but are generally applicable to the B. Mk. 2 also.

TYPE.—Four-jet medium bomber.

WINGS.—Mid-wing cantilever monoplane of delta planform. Thickness/chord ratio at centre-section/outer wing joint 10%. Chord at centre-section/outer wing joint approx. 46 ft. (14.0 m.). Aspect ratio Mk. 1 2.78, Mk. 2 3.1. Basic leading-edge sweepback of 50°, but with compound sweep on outer half of each wing, giving a 20% increase in chord from 78% span to tip. All-metal two-spar structure. Two ailerons and two elevators on each wing. Three position rotating-flap air-brakes extend above and below each centre-section.



The Avro Vulcan B. Mk. 2 Delta-wing Bomber.

FUSELAGE. –Circular-section all-metal semi-monocoque structure, with very large dielectric panel of double Fiberglas-Hycar sandwich construction.

TAIL UNIT.—Fin and rudder only. Of conventional all-metal construction.

LANDING GEAR.—Retractable tricycle type of Dowty design. Hydraulic retraction. Each main unit comprises an eight-wheel bogie. Twin nose-wheels. Dunlop wheels, tyres and hydraulic brakes with Maxaret anti-skid units. Emergency pneumatic extension. Large ribbon-type parachute brake.

POWER PLANT.—Four Bristol Olympus turbojets. Early Mk. 1 aircraft have 11,000 lb. (4,990 kg.) s.t. Olympus Mk. 101. Subsequent Mk. 1 aircraft have 12,000 lb. (5,443 kg.) s.t. Olympus Mk. 102 and 13,000 lb. (5,897 kg.) s.t. Olympus Mk. 104. Mk. 2 aircraft have 16,000 lb. (7,260 kg.) s.t. Olympus Mk. 200. Fuel tanks in outer wings, of flexible bag type. Flight refuelling probe in nose.

ACCOMMODATION.—Pressurised cabin for crew of five. Entrance hatch under nose. Two pilots on Martin-Baker ejection seats. Air electronics officer, navigator and radar operator side-by-side to rear in aft-facing seats.

DIMENSIONS (B. Mk. 1).—
Span 99 ft. (30.15 m.).
Length 97 ft. 1 in. (29.61 m.).
Height 26 ft. 6 in. (8.08 m.).

DIMENSIONS (B. Mk. 2).—
Span 111 ft. (33.83 m.).
Length 97 ft. 1 in. (29.61 m.).
Height 27 ft. 6 in. (8.38 m.).

THE AVRO TYPE 696 SHACKLETON.

The Shackleton is in service in R.A.F. Coastal Command.

Shackleton M.R. Mk. 1 and 1A. First production versions. Prototype Mk. 1 first flew on March 9, 1949. 77 built.

Shackleton M.R. Mk. 2. More powerfully armed and cleaner version of Mk. 1. New nose with two additional 20 mm. cannon aimed by gunner who sits above bomb-aimer. Fixed under-nose radome of Mk. 1 deleted and replaced in Mk. 2 by retractable radome located under fuselage aft of bomb-bay. Rear fuselage faired off with transparent terminal cone to provide look-out position. Single fixed tail-wheel of Mk. 1 replaced by twin retractable wheels. The Mk. 2 prototype flew for the first time on June 17, 1952.



The Avro Shackleton M.R. Mk. 3 Maritime Reconnaissance Monoplane (four 2,450 h.p. Rolls-Royce Griffon 67 engines).



The Avro Shackleton M.R. Mk. 3 as supplied to the South African Air Force.

At least one fitted with MAD submarine detection gear in tail "sting" fairing. Dimensions : Span same as for Mk. 1. Length 87 ft. 4 in. (26.6 m.). Height 16 ft. 9 in. (5.1 m.).

Shackleton M.R. Mk. 3. Developed version of Mk. 2. Nose-wheel landing-gear ; increased fuel capacity, incorporating wing-tip tanks ; new clear-view cockpit canopy ; internal changes for increased crew comfort, etc. In service with Royal Air Force and the South African Air Force. First production Mk. 3 (WR970) flew on September 2, 1955.

Shackleton T. Mk. 4. Mk. 1 converted for use by the Maritime Reconnaissance School as a navigation trainer.

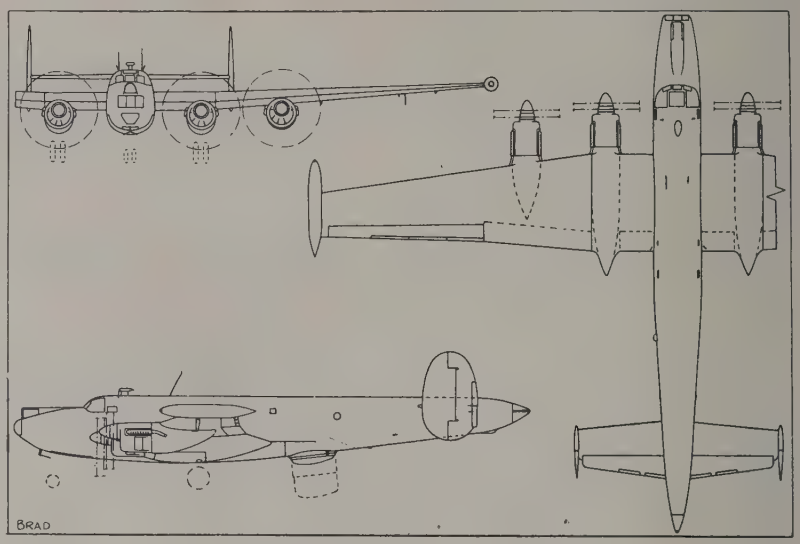
TYPE.—Four-engined Long-range Maritime Reconnaissance monoplane.

WINGS.—Cantilever mid-wing monoplane. Wing root aerofoil NACA 23018. Incidence 4°. Dihedral on outer planes (true) 4°. Two-spar all-metal structure. Hydraulically-operated split trailing-edge flaps, two between fuselage and inner nacelles, and two outboard of inner nacelles. Total flap area 187.3 sq. ft. (17.40 m.²). Ailerons in outer wing panels, with trim and balance tabs in each. Total aileron area 113.4. sq. ft. (10.55 m.²). Gross wing area 1,421 sq. ft. (132.4 m.²). T.K.S. porous-metal leading-edge de-icing.

FUSELAGE.—Light-alloy stressed skin semi-monocoque structure.

TAIL UNIT.—Cantilever monoplane tail and end-plate fins and rudders. All-metal structure. Total tailplane area 285.4 sq. ft. (26.6 m.²). Elevator area (including tabs) 87.30 sq. ft. (8.13 m.²). Trim-tab area (two) 3.56 sq. ft. (0.331 m.²). Balance tab area (two) 3.54 sq. ft. (0.329 m.²). Total vertical tail area 223 sq. ft. (20.75 m.²). Total rudder area (including combined balance/trim tabs) 100.2 sq. ft. (9.5 m.²). T.K.S. porous-metal leading-edge de-icing

LANDING GEAR.—Retractable tail-wheel (Mks. 1, 2 and 4 or nose-wheel (Mk. 3) type. Main wheels each carried between two oleo-pneumatic shock-absorbing legs, retract backward hydraulically into inner engine nacelles. Single fixed (Mk. 1) or dual retractable (Mk. 2) tail-wheel unit.



The Avro Shackleton M.R. Mk. 3.

POWER PLANT.—Four 2,450 h.p. Rolls-Royce Griffon 67 twelve-cylinder Vee liquid-cooled engines, each driving a de Havilland six-blade co-axial counter-rotating constant-speed fully-feathering airscrew, 13 ft. (3.96 m.) diameter.

ACCOMMODATION.—Crew of ten. Pilot's compartment in forward fuselage section, seating two side-by-side. Other crew positions in nose and fuselage.

ARMAMENT.—Two 20 mm. cannon in Bristol B.17 dorsal turret. Large single bomb compartment can accommodate variety of anti-shipping weapons in many combinations. Equipment includes extensive radio and radar, provision for carrying A/S.R. lifeboat, etc.

DIMENSIONS.—
Span (Mk. 1 and 2) 120 ft. 0 in. (36.6 m.).
Span (Mk. 3) 120 ft. 6¼ in. (36.75 m.).
Length (Mk 1.) 77 ft. 6 in. (23.6 m.).
Length (Mk. 2 and 3) 87 ft. 4 in. (26.6 m.).
Height (Mk. 1) 17 ft. 6 in. (5.3 m.).
Height (Mk. 2) 16 ft. 9 in. (5.1 m.).

WEIGHTS AND PERFORMANCE.—
No data available.



An Avro Shackleton M.R. Mk. 3 equipped with an A/S.R. lifeboat.

BLACKBURN



The Blackburn N.A.39 Naval Strike Aircraft (two D.H. Gyron Junior turbojet engines).

BLACKBURN AND GENERAL AIRCRAFT, LTD.

HEAD OFFICE AND WORKS: BROUGH, EAST YORKS.

LONDON OFFICE: 43, BERKELEY SQUARE, W.1.

Directors: E. Turner A.C.A. (Chairman and Managing Director), Major F. A. Bumpus, B.Sc., A.R.C.S., Wh.Sc., F.R. Ae.S., N. E. Rowe, C.B.E., B.Sc., M.I. Mech.E., F.R.Ae.S., Whit.Ex., Marshal of the Royal Air Force Sir John Slessor, G.C.B., D.S.O., M.C., Air Vice-Marshal H. N. Thornton, C.B.E., T. Bancroft, A. F. Jopling, A.C.A. and E. D. G. Lewin, C.B., C.B.E., D.S.O., D.S.C., R.N. (Retd.).

Secretary: R. H. Stone, A.C.A.

Chief Designer: B. P. Laight, A.F.R.Ae.S.

The Blackburn Aeroplane Company was founded by the late Mr. Robert Blackburn, who designed, built and flew his first aeroplane in 1909, and the company has continued to manufacture aircraft ever since.

In 1930 the Cirrus Hermes Engineering concern was taken over and Blackburns thus added aero-engines to their range of products.

In 1936 the Blackburn Aeroplane and Motor Co., Ltd. was turned into a public company under the name Blackburn Aircraft Ltd. and in January, 1949, Blackburn Aircraft Ltd. and General Aircraft Ltd. of Feltham, Middlesex, merged to form Blackburn and General Aircraft Ltd.

Since this merger, Blackburn and General Aircraft has developed the Beverley four-engined freighter, which is in service in the Royal Air Force.

A projected civil and military development of the Beverley, the B.107, on which the company is known to be working, will have Rolls-Royce Tyne turboprop engines, a re-designed pressurised fuselage and a retractable landing-gear, giving a considerably improved performance, with a maximum speed of approximately 360 m.p.h. (580 km.h.).

Blackburn and General Aircraft is also building a new naval strike aircraft known as the N.A.39.

THE BLACKBURN N.A.39.

The Blackburn N.A.39 is a transonic strike aircraft which is being developed for the Royal Navy as a replacement for the Westland Wyvern. A development batch of 20 aircraft was ordered in July, 1955 and the first of these flew for the first time on April 30, 1958.

The U.S. Government is bearing some of the cost of developing the N.A.39 and has provided a large amount of equipment of a type not available in the U.K. to assist rapid and effective flight testing.

Few details of the N.A.39 have been released officially, except that it carries a crew of two in tandem and is powered by two de Havilland Gyron Junior turbojets.

Details of the Cirrus Engine Division of Blackburn and General Aircraft, Ltd. will be found in the "Gas Turbine" and "Piston Engine" sections of this volume.

TYPE.—Two-seat Naval Strike aircraft.

WINGS.—Cantilever mid-wing monoplane. Broad-chord structure. Graded sweepback on leading-edges. Thin section. Structure is probably of multi-spar design with integrally-stiffened thick skins machined from the solid. Inboard trailing-edge flaps. "Super-circulation" boundary layer control, with air outlets near leading-edges and forward of ailerons and flaps.

FUSELAGE.—All-metal semi-monocoque structure, bulged at rear end in conformity with "area rule." Tail-cone made up of two sideways-hingeing air-brakes.

TAIL UNIT.—Cantilever monoplane type, with tailplane mounted at tip of fin. Large dorsal fin faired into fuselage dorsal fairing. All-moving tailplane attached to tip of fin which is pivoted to move with it. "Super-circulation" boundary layer control system.

LANDING GEAR.—Retractable tricycle type. Hydraulic retraction. Dowty levered-suspension design, with oleo shock-absorbers and single wheels on all units.

POWER PLANT.—Two de Havilland Gyron Junior turbojet engines, housed in nacelles on each side of fuselage.

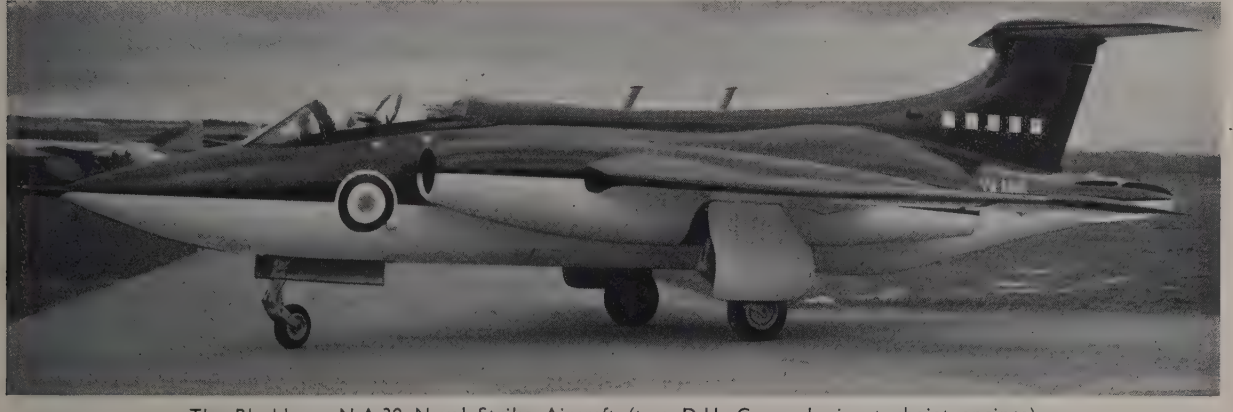
ACCOMMODATION.—Crew of two in tandem on Martin-Baker type 4M ejector seats under single transparent canopy.

ARMAMENT.—Large fuselage bomb-bay accommodates a variety of weapons, including nuclear stores.

DIMENSIONS, WEIGHTS AND PERFORMANCE.—No details available.

THE BLACKBURN BEVERLEY.

The Beverley C. Mk. 1 is the production version of the Universal four-engined transport which was basically a General Aircraft design. The first prototype, powered by four 2,020 h.p. Bristol Hercules 730 engines, was in an unfinished state when Blackburn and General Aircraft merged in 1949 and the aircraft was transferred to and completed at Brough. It flew for the first time on



The Blackburn N.A.39 Naval Strike Aircraft (two D.H. Gyron Junior turbojet engines).



The Blackburn Beverley C. Mk. 1 Military Transport (four 2,850 h.p. Bristol Centaurus 173 engines).

June 20, 1950. A second prototype with four 2,850 h.p. Bristol Centaurus engines and other modifications flew in June, 1953, and this aircraft served as the prototype for the Beverley.

The first production Beverley C. Mk. 1 made its maiden flight on January 29, 1955, and the type now equips several squadrons of R.A.F. Transport Command.

Assisted take-off experiments in 1956 showed that the use of ten Scarab rockets, mounted five on each side of the rear fuselage, enables a fully-loaded Beverley C. Mk. 1 to take off within 400 yards (365 m.). From two to ten rockets can be used as necessary.

TYPE.—Heavy Freight and/or Troop Transport and Tactical Support aircraft for the dropping of heavy stores and parachute troops.

WINGS.—High-wing cantilever monoplane. Modified R.A.F. 34 wing section. Aspect ratio 9. Dihedral 0°54′ inner wings, 3° 54′ outer wings. Chord 25 ft. 8 in. (7.84 m.) at root (on centre-line), 10 ft. 6 in. (3.2 m.) at tip. All-metal light alloy structure. Wing in four main sections, two inner and two outer, plus detachable tips, but no centre section. Thermal leading-edge de-icing. NACA slotted trailing-edge flaps over inner wing sections. Electric infinitely-variable flap operation. Modified Frise type ailerons, with trim and balance tabs on both sides. Flap area (each) 189 sq. ft. (17.5 m.²). Aileron area (aft of hinge) (each) 84 sq. ft. (7.8 m.²). Tab area (aft of hinge) (each) 5.5 sq. ft. (0.51 m.²). Gross wing area 2,916 sq. ft. (270 m.²).

FUSELAGE.—All-metal light-alloy structure in four sections ; nose compartment, main freight compartment, crew compartment. and tail boom compartment. Rear end of main freight compartment closed by pair of clamshell doors.

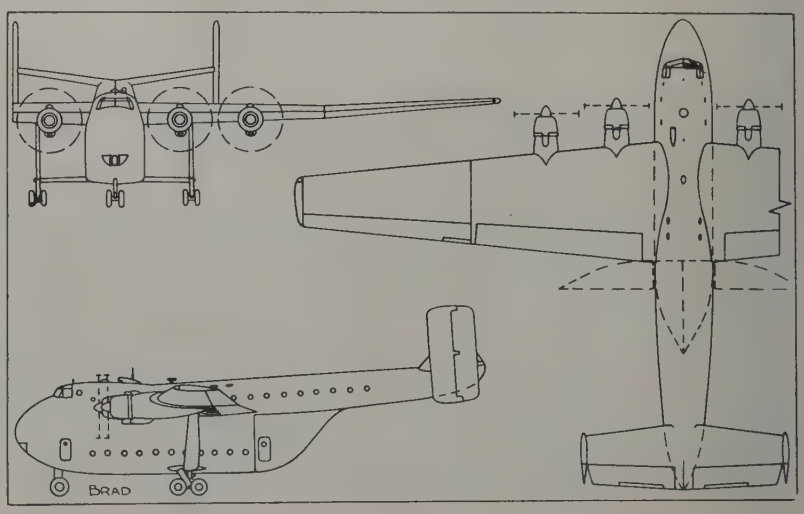
TAIL UNIT.—Cantilever monoplane tailplane with outrigged fins and rudders. De-icing on tailplane 7° 34′. Trim-tabs in all surfaces. Control systems for rudders and elevators operate the elevator and rudder tabs respectively. Gross tailplane and elevator area 526 sq. ft. (48.9 m.²). Total elevator area (aft of hinge) 145.15 sq. ft. (13.45 m.²). Trim-tab area each 7.41 sq. ft. (0.687 m.²). Gross fin and rudder area 391.2 sq. ft. (36.3 m.²). Total rudder area (aft of hinge) 62.4 sq. ft. (5.79 m.²). Trim-tab area each 6.26 sq. ft. (0.585 m.²). Tailplane span 43 ft. 2 in. (15.10 m.).

LANDING GEAR.—Fixed nose-wheel type with four-wheel bogie main units. Main wheels mounted on beam which is pivoted on Lockheed main shock-absorber and sprung by Lockheed damper strut. Normal wheels have tyres with pressure of 80 lbs./sq. in. Alternative wheels for operation from soft strips may be substituted. These have a pressure of 48 lb./sq. in., the tyres being identical to those used on the nose wheel. Twin Dunlop nose wheels sprung by Lockheed shock-absorber leg. Nose-wheel unit can be power-steered through an angular movement of ± 45°. Hydraulic differential braking on main wheels, which incorporate the Maxaret non-skid system. Wheelbase (between C/L of struts) 28 ft. 8 in. (8.74 in.). Track (between C/L of struts) 33 ft. 5 in. (10.18 m.).

POWER PLANT.—Four Bristol Centaurus 173 eighteen-cylinder radial air-cooled engines with single-speed superchargers, each developing 2,850 h.p. for take-off at 2,800 r.p.m. with water/methanol injection. Rated powers ; normal climb and continuous rich mixture cruising, 2,390 h.p. at 4,500 ft. (1,370 m.) ; lean mixture continuous cruising 1,720 h.p. at 11,500 ft. (3,500 m.). Access to equipment in engine nacelles (not to power-units) in flight or for ground maintenance through rear auxiliary bulkhead from internal wing crawlway. D.H. four-blade hollow steel reversible-pitch braking airscrews 16 ft. 6 in. (5.03 m.) diameter, with electric de-icing. Up to ten Scarab solid-propellent rockets may be mounted on rear fuselage to assist take-off when necessary. Fuel is carried in eight flexible tanks, four in each wing. Capacities are : No. 1 tanks 1,040 Imp. gallons (4,720 litres) each, No. 2 tanks 1,140 Imp. gallons (5,180 litres) each, No. 3 tanks 660 Imp. gallons (2,970 litres) each, No. 4 tanks 600 Imp. gallons (2,720 litres) each. Total fuel capacity 6,880 Imp. gallons (31,300 litres). No. 2 tanks are bullet-proof and Nos. 1 and 2 tanks have fire-extinguishers. Pressure fuelling and de-fuelling is provided for all tanks from points on the fuselage sides at the sponson leading-edge.

ACCOMMODATION.—Flight deck laid out for crew of four, two pilots, radio operator and navigator. Sighting position for supply dropping in extreme nose and despatchers' positions are provided adjacent to parachute exits. Main freight compartment is 40 ft. long, 10 ft. high and 10 ft. wide (12.2 m. × 3.05 m. × 3.05 m.), and the tail compartment is 44 ft. long, 6 ft. high and 8 ft. 6 in. wide (13.4 m. × 1.83 m. × 2.59 m.). Floors of both compartments have flush lashing points/seat attachments on a 20-inch grid and lashing rings and rails are provided on walls of the main freight compartment. Floor of main freight compartment stressed for a loading of 325 lb./sq. ft., with reinforcement for wheeled vehicles with an axle load of up to 12,500 lb. (5,675 kg.). The following are the standard complements :—Troops 94 (58 in freight and 36 in tail compartments), Paratroops 70 (40 in freight and 30 in tail compartments), Ambulance 82 (48 stretcher cases in freight and 34 sitting cases in tail compartments). Heavy drop platform retaining and release gear is provided for individual loads of up to 25,000 lb. (11,350 kg.) and divided loads of up to full military load. The rear fairing doors are removed for dropping operations. Hinged loading ramps at rear of freight floor may be removed when not required.

DIMENSIONS.—
Span 162 ft. (49.5 m.).



The Blackburn Beverley C. Mk. 1 Military Transport.



A model of the projected Blackburn B-107A Tactical and Strategic Transport, a Stage 3 Beverley development powered by four Rolls-Royce Tyne turboprop engines.

Length 99 ft. 5 in. (30.3 m.).
Height overall 38 ft. 5 in. (11.7 m.).

WEIGHTS AND LOADINGS.—
Basic weight (normal equipment) 82,100 lb. (37,273 kg.).
Payload, fuel and oil 52,900 lb. (24,020 kg.).
Gross weight 135,000 lb. (61,200 kg.).
Wing loading 46.4 lb./sq. ft. (226.5 kg./m.²).
Power loading 11.84 lb./h.p. (5.37 kg./h.p.).

PERFORMANCE.—
Max. speed 238 m.p.h. (384 km.h.) at 5,700 ft. (1,740 m.).
Max. continuous cruising speed 223 m.p.h. (359 km.h.) at 5,000 ft. (1,525 m.).
Max. lean mixture cruising speed 194 m.p.h. (312 km.h.) at 12,500 ft. (3,800 m.).
Recommended cruising speed 175 m.p.h. (282 km.h.) at 8,000 ft. (2,440 m.).
Take-off distance to 50 ft. (15.25 m.) 1,340 ft. (408 m.).
Landing distance from 50 ft. (15.25 m.) 910 ft. (277 m.).
Range with 1,000 lb. (454 kg.) payload at 188 m.p.h. (302 km.h.) at 8,000 ft. (2,440 m.) 3,690 miles (5,938 km.).
Range with 44,000 lb. (19,958 kg.) payload at 145 m.p.h. (233 km.h.) at 8,000 ft. (2,440 m.) 200 miles (322 km.).

BOULTON PAUL

BOULTON PAUL AIRCRAFT, LTD.

HEAD OFFICE, WORKS AND AERODROME WOLVERHAMPTON.

OTHER WORKS: SEIGHFORD AERODROME, NR. STAFFORD.

LONDON OFFICE: KINNAIRD HOUSE, 1, PALL MALL EAST, S.W.1.

Incorporated: June, 1934.

Chairman and Managing Director: J. D. North, F.R.Ae.S., M.I.Mech.E., F.S.S.

Directors: G. C. Haynes, A.C.A. (Deputy Managing); R. Beasley, F.R.Ae.S., M.I.P.E.; F. F. Crocombe, B.Sc., A.C.G.I., D.I.C., F.R.Ae.S. (Chief Engineer); Sir Harold Roxbee Cox, D.Sc., Ph.D., F.R.Ae.S., M.I.Mech.E.

Secretary: G. A. Woolsey, A.C.A.

Boulton Paul Aircraft Ltd. was formed in 1934 to take over the old-established Aircraft Department of Boulton & Paul Ltd. of Norwich which began the manufacture of aircraft in 1915.

In addition to the design and construction of aircraft, Boulton Paul has designed and produced an extensive range of electro-hydraulically operated gun-turrets. More recently, the company has specialised in the development of electronic aids to research, testing and design. It has also developed high-fidelity power control systems for aircraft and units of this type are incorporated in the Vickers Valiant and Avro Vulcan bombers, and other types.

One development of this work, tested on the Tay-Viscount aircraft under Ministry of Supply Contract, enables the aircraft to be flown on electrical signals transmitted by the pilot to the power controls.

The first aircraft produced by the company after the War was the Balliol two-seat trainer with a Rolls-Royce Merlin engine, which went into service with the Royal Air Force, the Royal Navy and the Ceylon Air Force. More recently Boulton Paul designed and built the P.111 delta-wing high-speed research monoplane. Both these aircraft have been illustrated and described in previous editions of "All the World's Aircraft."

Boulton Paul were responsible for developing the English Electric Canberra T. Mk. 11 radar trainer from the B. Mk. 2 bomber version.

BRISTOL

THE BRISTOL AEROPLANE CO., LTD.

HEAD OFFICE: FILTON, BRISTOL.

LONDON OFFICE: 6, ARLINGTON STREET, ST. JAMES'S, S.W.1.

Directors: Sir Reginald Verdon Smith, M.A., B.C.L., J.P. (Chairman and Joint Managing); Sir G. Stanley White (Deputy Chairman); G. S. M. White (Joint Managing); Capt. K. J. G. Bartlett, C.B.E., A.F.R.Ae.S.; C. F. Uwins, O.B.E., A.F.C. (Deputy Chairman); Brian Davidson; A. E. Russell, C.B.E., D.Sc., F.R.Ae.S.; Air Chief Marshal Sir W. Alec Coryton, K.C.B., K.B.E., M.V.O., D.F.C.; William Masterton, C.A.; Dr. S. G. Hooker, O.B.E., D.Ph., D.I.C., F.R.Ae.S.; Air Cdre. F. R. Banks, C.B., O.B.E.; Rear Admiral Sir Matthew S. Slattery, C.B., D.Sc., F.R.Ae.S.

Secretary: J. W. Reader Harris.

The Bristol Aeroplane Co., Ltd., is the holding company for the following British and overseas subsidiary companies:—Bristol Aircraft, Ltd.; Bristol Aero-Engines, Ltd.; Bristol Cars, Ltd.; The Bristol Aeroplane Company of Canada, Ltd., Montreal; Bristol Aero Engines, Ltd., Montreal; Bristol Aero Engines (Western), Ltd., Vancouver; Bristol Aircraft (Western), Ltd., Winnipeg; The Bristol Aeroplane Company (Australia), Pty., Ltd., Melbourne; Bristol Aviation Services, Pty., Ltd., Sydney; Bristol Aeroplane Company (New Zealand), Ltd., Wellington; Bristol de Mexico S.A., Mexico City; The Bristol Aeroplane Company (U.S.A.) Inc., New York; Bristol Aeroplane Company (S.A.) (Pty.) Ltd., Johannesburg.

Details of the products of Bristol Aircraft, Ltd., follow hereunder. Products of Bristol Aero-Engines, Ltd, are fully described in the Engine Section.

BRISTOL AIRCRAFT, LTD.

HEAD OFFICE, WORKS AND AERODROME: FILTON, BRISTOL.

OTHER WORKS: WESTON-SUPER-MARE AND CARDIFF.

LONDON OFFICE: 6, ARLINGTON STREET, ST. JAMES'S, S.W.1.

Directors: Rear Admiral Sir Matthew S. Slattery, C.B., D.Sc., F.R.Ae.S. (Chairman); P. G. Masefield, M.A.(Eng.), C.I.Mech.E., F.R.Ae.S., F.I.Ae.S., M. Inst.T. (Managing); J. F. Harper (Assistant Managing); Sir Reginald Verdon Smith, M.A., B.C.L., J.P.; C. F. Uwins, O.B.E., A.F.C., F.R.Ae.S.; Brian Davidson; A. E. Russell, C.B.E., D.Sc., F.R.Ae.S., F.I.Ae.S. (Chief Engineer); Air Cdre. F. R. Banks, C.B., O.B.E.; R. S. Brown (Works Director); W. R. Farnes, O.B.E. (Sales); T. B. Pritchard (Financial) and G. E. Knight (Commercial).

Secretary: A. D. Cawse.

General Manager, Weston division: W. Strachan.

Chief Designer (Fixed-wing Aircraft): W. J. Strang, B.Sc., Ph.D., A.F.R.Ae.S.

Chief Designer (Rotary-wing Aircraft): R. Hafner, F.R.Ae.S.

Chief Designer (Guided Missiles): D. J. Farrar, M.A., A.F.R.Ae.S.

Bristol Aircraft, Ltd. is a subsidiary of the Bristol Aeroplane Company, Ltd., which was founded in 1910 and was known originally as The British and Colonial Aeroplane Company, Ltd.

Now in production are the Bristol Type 175 Britannia medium/long-range airliner, on order for B.O.A.C. and other operators, the Type 171 helicopter, and the twin-engined/twin-rotored Type 192 helicopter which is a development of the Type 173 research aircraft.

In order to meet production requirements, a second production line for the Britannia has been set up at Belfast by Short Brothers & Harland, Ltd.

To extend the progress of co-operation between Bristol Aircraft and Short Brothers and Harland, in which Bristol has a share-holding, Rear Admiral Sir Matthew Slattery, Chairman and Managing Director of Short Brothers and Harland was elected a Director of The Bristol Aeroplane Company and appointed Chairman of Bristol Aircraft in October, 1957.

Canadair, Ltd. of Montreal, P.Q. is building a long-range maritime reconnaissance version of the Britannia, known as the CL-28 Argus, for the Royal Canadian Air Force and a military transport



The Bristol Britannia 102 Airliner (four 3,900 e.h.p. Bristol Proteus 705 turboprop engines).

version of this type under the designation CL-44. Details of these aircraft will be found under "Canadair."

Bristol Aircraft are also engaged on the development of guided weapons and it was announced early in 1957 that their Bloodhound surface-to-air missile would be the first weapon of this type to enter service with the Royal Air Force in 1958. Details of the Bloodhound will be found in the "Guided Missiles" section of this work.

Another important activity of Bristol Aircraft is the production of plastic drop fuel tanks, which are standard on many British military aircraft types.

Early in 1957, the company's factories at Oldmixon, where all helicopter work is concentrated, and at Banwell, where rocket-motor tubes and high-pressure gas storage vessels are manufactured, were incorporated in a newly-formed Weston division, under their own general manager.

THE BRISTOL TYPE 175 BRITANNIA.

A fleet of 33 Britannias is being built for B.O.A.C. and the first of these aircraft entered scheduled service on February 1, 1957. The Britannia is a considerable advance on the Medium-Range Empire transport proposed by B.O.A.C. in 1947. All the aircraft at present under construction have four Bristol Proteus turboprop engines.

The Britannia was awarded its U.S. airworthiness certificate on April 10, 1958.

The four main versions of the Britannia are distinguished by the Series numbers 100, 250, 300 and 310.

The **100 SERIES** is powered by four 3,900 e.h.p. Proteus 705 engines and has a basic interior layout for from 60 first-class to 92 tourist class passengers. It includes the following production version :—

Britannia 102. First production version. Fifteen for B.O.A.C. The first (G-ANBA) flew on September 15, 1954, and deliveries to B.O.A.C. were completed in August, 1957.

The **250 SERIES** is a mixed cargo/passenger version. It is similar to the 310 Series (see below) with lengthened fuselage and 4,120 e.h.p. Proteus 755 engines. Forward freight compartment has strengthened floor. The following versions have been ordered :—

Britannia 252. Three long-range trooping aircraft for the Ministry of Supply. Being built by Short Bros. & Harland, Ltd., Belfast.

Britannia 253. Twenty long-range aircraft for R.A.F. Transport Command. Accommodation for 115 troops, 53 stretcher cases or equivalent freight. Being built by Short Bros. & Harland, Ltd., Belfast.

The **300 SERIES** is a development of the 100 Series with the 10 ft. 3 in. (3.12 m.) longer fuselage and Proteus 755 engines. Accommodation for up to 133 tourist class passengers. This series includes the following production versions :—

Britannia 302. First production version of 300 Series. Two for Aeronaves de Mexico. Built by Short Bros & Harland, Ltd., Belfast.

Britannia 305. Five ordered by North-east Airlines, who failed to take delivery. Similar to 302 but with strengthened wings and Series 310 wing fuel tankage for long-range operation. Built by Short Bros & Harland, Ltd., Belfast. One leased by El Al pending delivery of fourth Britannia 313.

Britannia. 307. One for Air Charter Ltd. Furnished to seat over 100 passengers.

The **310 Series** is a long-range version of the 300 with additional wing tankage. This Series includes :—

Britannia 311. Prototype (G-AOVA) of 310 Series. First flew on December 31, 1956. Later converted to 312 standard for delivery to B.O.A.C. (see below).

Britannia 312. Eighteen for B.O.A.C.

Britannia 313. Four for El Al, Israel Airlines.

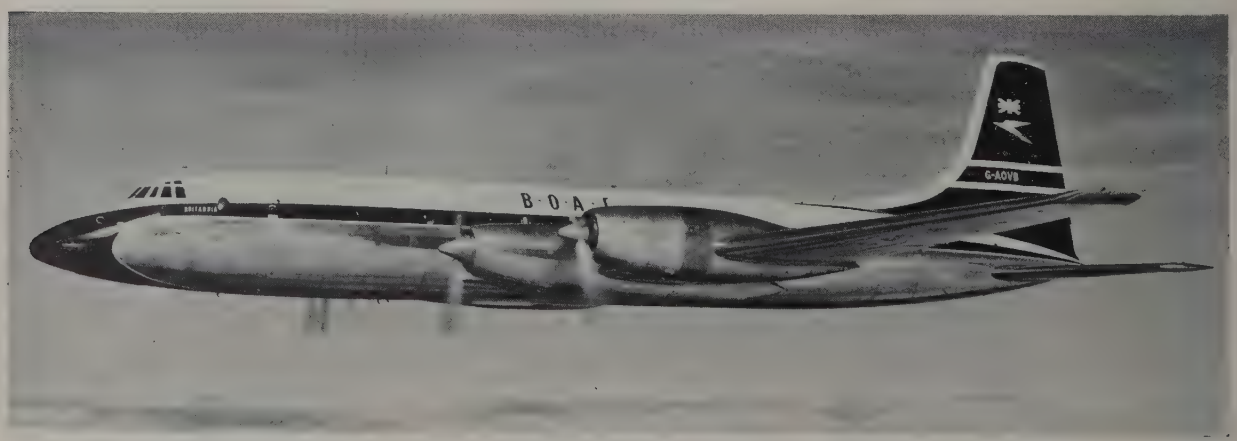
Britannia 314. Six for Canadian Pacific Airlines, with option for further five. Built by Short Bros & Harland, Ltd., Belfast.

Britannia 317. Two for Hunting-Clan Airlines, Ltd., with option for one more.

Britannia 318. Four for Compania Cubana de Aviacion.

The high-density medium range versions of the 310 Series with accommodation for up to 133 passengers are economically competitive over stage lengths from 200 to 2,600 miles (320-4,200 km.) when operated at a reduced all-up weight, and have a guaranteed cruising speed of 400 m.p.h. (645 km.h.). These versions can be fitted with integral passenger steps.

The **320 SERIES** is a progressive development of the 310 with a number of improvements, including installation of more powerful Proteus 765 turboprop engines.



The Bristol Britannia 312 Airliner (four 4,120 e.h.p. Bristol Proteus 755 turboprop engines).

TYPE.—Four-engined Airliner.

WINGS.—Low-wing cantilever monoplane. Wing section NACA 25017 at root, tapering to NACA 4413 modified at tip. Aspect ratio 9.76. Dihedral constant from roots, 3°. Incidence 3° at root, 0.6° at tip. Root chord 22 ft. 7¼ in. (6.88 m.). Aluminium-alloy box-spar stressed skin structure. Servo-tab-operated ailerons in outer wings and double-slotted trailing-edge flaps each side on inner wing. Thermal anti-icing. Total area of ailerons 70 sq. ft. (6.52 m.²). Total area of flaps 401 sq. ft. (37.25 m.²). Gross wing area 2,075 sq. ft. (192.7 m.²).

FUSELAGE. — Aluminium - alloy monocoque structure pressurised to 8.25 lb./sq. in. Maximum diameter 12 ft. (3.66 m.).

TAIL UNIT.—Cantilever metal tailplane and single fin and rudder. Aluminium-alloy box spar structure. Servo tabs in all control surfaces. Areas: fin 264.2 sq. ft. (24.5 m.²), rudder 92.2 sq. ft. (8.56 m.²), tailplane 418 sq. ft. (38.8 m.²), elevators 170 sq. ft. (15.6 m.²). Tailplane span 55 ft. (16.7 m.).

LANDING GEAR.—British Messier retractable nose-wheel type. Main units beneath inner nacelles each have a four-wheel bogie. Nose unit has twin wheels. Hydraulic retraction. Dunlop wheels and Dunlop Maxaret hydraulic brakes. Wheel track (bogie centres) 31 ft. 0 in. (9.45 m.). Wheel-base 35 ft. 3.4 in. (10.80 m.).

POWER PLANT.—Four 3,900 e.h.p. Bristol Proteus 705 (100 Series) or 4,120 e.h.p. Proteus 755 (250, 300 and 310 Series) or 4,445 e.h.p. Proteus 765 (320 Series) turboprop engines driving de Havilland hydromatic four-blade airscrews. Main fuel tankage in wing-spar box. Total internal fuel capacity (100 and 300 Series) 6,670 Imp. gallons (30,327 litres). Total internal fuel capacity (250 and 310 Series) 8,486 Imp. gallons (38,576 litres). Total internal fuel capacity (320 Series (8,580 Imp. gallons (39,000 litres). Total oil capacity (all versions) 36 Imp. gallons (164 litres).

ACCOMMODATION (100 Series).—Crew of 8 and up to 92 passengers in pressurized cabin. Main passenger accommodation in two cabins, in centre fuselage and rear fuselage, with main entrance (port side) between. Additional entrance and pantry forward. Basic 92-seat tourist layout capable of conversion without structural alteration to alternative arrangements providing reduced seating capacity at first class standards. Baggage compartment immediately aft of flight deck. Freight holds below cabin floor.

ACCOMMODATION (250 Series).—Crew of 7 and 84 passengers (basic tourist layout). Freight compartment capacity 824 cub. ft. (23.33 m.³) on main deck, in addition to freight holds below cabin floor. Capable of conversion without structural alteration to alternative layout providing 13 additional seats instead of cargo and two additional seats in lieu of pantry equipment.

ACCOMMODATION (300 Series).—Crew of 9 and up to 133 passengers (basic tourist layout), capable of conversion without structural alterations to alternative layouts providing reduced seating capacity at first-class standards.

ACCOMMODATION (310 Series).—Crew of 9 and up to 133 passengers (basic tourist day layout), capable of conversion without structural alteration to mixed first-class/tourist day seating or wholly or partially to first-class seating or sleeping berth accommodation. Alternative seating arrangements are for 73 or 93 passengers, with an eight-seat "club" lounge in the rear fuselage.

DIMENSIONS (100 Series).—
Span 142 ft. 3½ in. (43.38 m.).
Length 114 ft. (34.77 m.).
Height 36 ft. 8.3 in. (11.19 m.).

DIMENSIONS (250,300 and 310 Series).—
Span 142 ft. 3½ in. (43.38 m.).
Length 124 ft. 3 in. (37.89 m.).
Height 37 ft. 6 in. (11.43 m.).

WEIGHTS (100 Series).—
Weight empty 88,000 lb. (39,916 kg.).
Max. payload 25,000 lb. (11,340 kg.).
Max. all-up weight 155,000 lb. (70,370 kg.).
Max. landing weight 125,000 lb. (56,700 kg.).

WEIGHTS (Model 252).—
Weight empty 94,000 lb. (42,637 kg.).
Max. payload 28,000 lb. (12,700 kg.).
Max. all-up weight 180,000 lb. (81,646 kg.).
Max. landing weight 135,000 lb. (61,235 kg.).

WEIGHTS (Model 253 freighter).—
Weight empty 88,250 lb. (40,029 kg.).
Max. payload 34,000 lb. (15,422 kg.).
Max. all-up weight 180,000 lb. (81,646 kg.).
Max. landing weight 135,000 lb. (61,235 kg.).

WEIGHTS (Model 302).—
Weight empty 92,500 lb. (41,957 kg.).
Max. payload 30,000 lb. (13,608 kg.).
Max. all-up weight 165,000 lb. (74,842 kg.).
Max. landing weight 135,000 lb. (61,235 kg.).

WEIGHTS (Model 305). -
Weight empty 90,500 lb. (41,050 kg.).
Max. payload 28,000 lb. (12,700 kg.).
Max. all-up weight 175,000 lb. (79,378 kg.).
Max. landing weight 135,000 lb. (61,235 kg.).

WEIGHTS (Models 312 and 320).—
Weight empty 92,000 lb. (41,730 kg.).
Max. payload 28,000 lb. (12,700 kg.).
Max. all-up weight 180,000 lb. (81,646 kg.).
Landing weight 135,000 lb. (61,235 kg.).

PERFORMANCE (100 Series).—
Normal high-speed cruise at 140,000 lb. (63,400 kg.) A.U.W. 361 m.p.h. (580 km.h.).
Long-range cruising speed at 140,000 lb. (63,400 kg.) A.U.W. 328 m.p.h. (527 km.h.)
Still-air range with max. payload (25.000 lb.=11,340 kg.) 3,450 miles (5,552 km.) at 328 m.p.h. (527 km.h.).
Still-air range with 13,736 lb. (6,231 kg.) payload and full tanks 4,580 miles (7,371 km.) at 328 m.p.h. (527 km.h.).
Take-off distance to 50 ft. (15.25 m.) at S/L, I.S.A. at max. A.U.W. 6,310 ft. (1,923 m.).
Landing distance from 50 ft. (15.25 m.) at S/L, I.S.A., at max. landing weight 5,210 ft. (1,588 m.).

PERFORMANCE (Model 252).—
Cruising speed as for Model 302.
Still-air range with max. payload (28,000 lb.=12,700 kg.) 4,320 miles (6,951 km.) at 357 m.p.h. (575 km.h.).
Still-air range with 17,454 lb. (7,917 kg.) payload and full tanks 5,310 miles (8,545 km.) at 357 m.p.h. (575 km.h.).
Take-off distance to 50 ft. (15.25 m.) at S/L, I.S.A. at max. A.U.W. 7,200 ft. (2,195 m.).
Landing distance from 50 ft. (15.25 m.) at S/L, I.S.A. at max. landing weight 5,900 ft. (1,798 m.).

PERFORMANCE (Model 253 freighter).—
Cruising speed as for Model 302.
Still-air range with max. payload (34,000 lb.=15,422 kg.) 4,310 miles (6,936 km.) at 357 m.p.h. (575 km.h.).
Still-air range with 23,372 lb. (10,601 kg.) payload and full tanks 5,310 miles (8,545 km.) at 357 m.p.h. (575 km.h.).
Take-off and landing distances as for Model 252.

PERFORMANCE (Model 302).—
Normal high-speed cruise at 140,000 lb. (63,400 kg.) A.U.W. 397 m.p.h. (639 km.h.).
Long-range cruising speed at 140,000 lb. (63,400 kg.) A.U.W. 357 m.p.h. (575 km.h.).
Still-air range with max. payload (30,000 lb.=13,608 kg.) 3,300 miles (5,311 km.) at 357 m.p.h. (575 km.h.).
Still-air range with 19,127 lb. (8,676 kg.) payload and full tanks 4,320 miles (6,951 km.) at 357 m.p.h. (575 km.h.).
Take-off distance to 50 ft. (15.25 m.) at S/L, I.S.A., at max. A.U.W. 5,900 ft. (1,798 m.).
Landing distance from 50 ft. (15.25 m.) at S/L, I.S.A., at max. landing weight 5,900 ft. (1,798 m.).

PERFORMANCE (Model 305).—
Cruising speed as for Model 302.
Still-air range with max. payload (28,000 lb.=12,700 kg.) 4,330 miles (6,968 km.) at 357 m.p.h. (575 km.h.).
Still-air range with 16,012 lb. (7,263 kg.) payload and full tanks 5,500 miles (8,851 km.) at 357 m.p.h. (575 km.h.).
Take-off distance to 50 ft. (15.25 m.) at S/L, I.S.A. at max. A.U.W. 6,750 ft. (2,057 m.).
Landing distance from 50 ft. (15.25 m.) at S/L, I.S.A., at max. A.U.W. 5,900 ft. (1,798 m.).

PERFORMANCE (Models 312 and 320).—
Cruising speed as for Model 302.
Still-air range with max. payload (28,000 lb.=12,700 kg.) 4,680 miles (7,532 km.) at 357 m.p.h. (575 km.h.).
Still-air range with 19,584 lb. (8,883 kg.) payload and full tanks 5,520 miles (8,883 km.) at 357 m.p.h. (575 km.h.).
Take-off and landing distances as for Model 252.

THE BRISTOL TYPE 191.

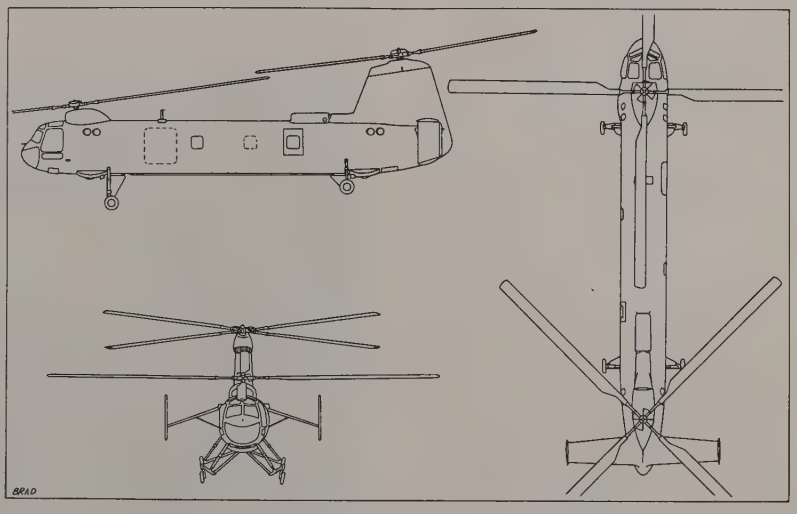
Quantity production of this twin-rotor helicopter for service with the Royal Navy was originally contemplated; but following a re-assessment of naval aircraft requirements, arising from changed strategic circumstances, it was decided to limit production to a small number of prototypes required for essential development work in connection with the Type 192.

THE BRISTOL TYPE 192.

The Type 192 twin-rotor helicopter has been ordered for service with the Royal Air Force. A civil variant known as the Type 192C has also been projected, together with design studies for larger civil and military helicopters of the same configuration.

The Type 192 has been designed to meet requirements for a large helicopter capable of troop and freight transport, paratrooping, supply dropping, ambulance duties and search-and-rescue operations. It is fully-equipped for day and night instrument flying, with provision for an automatic pilot and dual controls. The crew stations are heated.

The Type 192 Series 2, now in production, has two Napier Gazelle Series 2 gas-turbine engines, each developing 920 h.p. continuous power, with a one-hour rating of 1,300 h.p. and 2½ minute rating of 1,650 h.p. Normal fuel capacity is 560 Imp. gallons (2,545 litres). For ferrying purposes two additional tanks of 260 Imp. gallons (1,180 litres) capacity each can be installed in the fuselage, increasing the total capacity to 1,080 Imp. gallons (4,905 litres).



The Bristol Type 192 Series 2 Helicopter.



The Bristol Model 192 Series 2 Helicopter (two Napier Gazelle Series 2 gas-turbine engines).

No prototype as such is being built and the first Type 192 Series 2 of the production series flew for the first time on July 5, 1958.

ACCOMMODATION.—Crew of two, with 12 stretcher cases in tiers of three, three sitting wounded and a medical orderly in ambulance rôle ; an aircrewman and ten or more persons in search and rescue rôle ; maximum distributed load of 6,000 lb. (2,721 kg.) for freight duties ; or 18-25 fully-armed troops according to range. Cabin is 24 ft. 1 in. long, 5 ft. 3 in. wide and 4 ft. 11 in. high (7.34 × 1.60 × 1.50 m.). Loading winch can lift loads up to 600 lb. (270 kg.). Loads up to 5,250 lb. (2,380 kg.) can be carried externally under fuselage, with mechanical or electrical quick-release gear.

DIMENSIONS.—
Diameter of rotors each 48 ft. 8 in. (14.83 m.).
Length overall 89 ft. 9¼ in. (27.35 m.).
Distance between rotor centres 41 ft. 1¼ in. (12.53 m.).
Height 17 ft. (5.18 m.).

WEIGHT AND LOADINGS.—
Basic operational weight 10,913 lb. (4,950 kg.).
Max. loaded weight 18,000 lb. (8,165 kg.).
Disc loading 4.83 lb./sq. ft. (23.57 kg./m.²).
Power loading 9.8 lb./h.p. (4.44 kg./h.p.).

PERFORMANCE (at S/L, I.S.A. at max. A.U.W.).—
Cruising speed 138 m.p.h. (222 km.h.).
Vertical rate of climb on two engines, each giving 920 h.p. 500 ft./min. (150 m./min.).
Max. rate of climb with forward speed 1,175 ft./min. (358 m./min.).
Rate of climb on one engine, giving 1,300 h.p. 160 ft./min. (50 m./min.).
Rate of climb on one engine at emergency power 760 ft./min. (230 m./min.).
Service ceiling 13,250 ft. (4,040 m.).
Hovering ceiling without ground effect 8,000 ft. (2,440 m.).
Range with 6,000 lb. (2,721 kg.) payload 75 miles (120 km.).
Range with 2,600 lb. (1,180 kg.) payload 432 miles (695 km.).

THE BRISTOL TYPE 171 SYCAMORE.

The Type 171, which first flew in 1947, was the first rotating wing aircraft to be built by the Bristol company. In service as a civil transport and in a number of military and naval rôles, the Type 171 provides accommodation for five persons, including one or two pilots. The standard power-unit is the Alvis Leonides Mk. 173.

Over 160 of these helicopters have been delivered and production in the Spring of 1958 was approximately four aircraft per month.

The current versions are :—

Type 171 Mk. 4. Current production version for casualty evacuation and search and rescue, but capable of conversion for passenger and freight transport. The change-over from one version to another can be made rapidly.

The following military versions have also been produced :—

Sycamore H.C. Mk. 10. Primarily an ambulance with accommodation for two standard stretchers carried athwartships at back of cabin, one above the other. Ends of stretchers accommodated by Perspex blisters, one on each side of cabin. Swivel seat for medical attendant.

Sycamore H.C. Mk. 11. Communications, observation and transport version in service with British Army. Standard R.A.F. and Army radio. Rope ladder for use over unsuitable landing terrain. Strong points under fuselage for carrying loads up to 1,600 lb. (726 kg.).

Sycamore H.R. Mk. 12. Search and rescue or communications aircraft in service with R.A.F. Coastal Command.

Sycamore H.R. Mk. 13. Search and rescue or communications aircraft in service with R.A.F. Fighter Command.

Sycamore H.R. Mk. 14. Search and rescue, ambulance or communications aircraft for service with the R.A.F.

Sycamore H.R. Mk. 50 and 51. Search and rescue or communications aircraft in service with the Royal Australian Navy. Similar to Mks. 13 and 14 respectively. Hydraulically operated winch on starboard side of fuselage. Seats of folding "deck chair" type, to give increased working space for winch operation and rescue work. Open starboard doorway covered by quick-release curtain for rescue missions. In communications rôle winch is removed and starboard door aperture covered by metal panel containing a knock-out Perspex escape hatch. Side exhaust to avoid burning or scorching when landing in scrub or on ship's deck. Modified instrument panel layout.

Sycamore Mk. 52. In service with the Federal German Forces. Basically similar to H.R. Mk. 14.

The description below refers primarily to the Mk. 4 version which is now in production.

TYPE.—Four or Five-seat Civil or Military Helicopter.

ROTOR SYSTEM.—Three-blade main rotor and three-blade anti-torque rotor. Blades, of Bristol design, of wooden construction with Hydulignum spar along leading-edge, spruce and ply ribs and plywood covering. Two sheet metal tabs, one in vicinity of blade tip and the other near root, correct aerodynamic balance. Blades fully articulated in both flapping and drag planes. Adjustable friction dampers on drag hinges, and spacer rods with rubber buffers between blades. All-metal blades are now being developed.

ROTOR DRIVE.—Drive from engine taken through centrifugal clutch via a vertical shaft to main gear-box below rotor head, which has a two-stage spur reduction gear. From this main gear-box a further drive is taken to shaft which runs down rear fuselage through constant-velocity Hardy Spicer universal joint to a bevel gear-box and so to tail rotor. Free wheel and clutches ensure both main and tail rotors will autorotate in event of engine failure. Rotor brake on tail-drive output of main rotor gear-box. Accessories driven from main rotor gear-box, so that they continue to function in event of engine failure.

FUSELAGE.—In four sections, front, centre, intermediate and tail. Front section is



The Bristol Sycamore H.R. Mk. 14 Helicopter (520 h.p. Alvis Leonides engine).



Two Bristol Sycamore Mk. 52 Helicopters in the colours of armed forces of the Federal German Republic.

metal monocoque with Perspex and metal fairing. Centre-section has welded steel-tube frames with metal skin. Intermediate and tail sections are metal monocoque.

LANDING GEAR.—Fixed tricycle type with castoring nose-wheel. Pneumatic shock-absorbers to all three wheels. Tail skid aft to prevent damage to tail rotor. Wheel track 9 ft. (2.74 m.).

POWER PLANT.—One 500/520 h.p. Alvis Leonides Mk. 173 (civil designation) 524/1 nine-cylinder radial air-cooled engine mounted with crankshaft vertical in fuselage centre-section. Engine-driven cooling fan draws air through intake above cabin. Air is ducted from fan past fully-cowled and baffled engine and exhausted through grille at bottom of fuselage centre-section. Steel cowling above cylinder and steel bulkheads below, enclose engine in fireproof box. Graviner spray-ring fire-extinguisher system controllable by pilot. Bag-type fuel cell behind rear engine bulkhead in intermediate fuselage. Normal fuel capacity 65 Imp. gallons (295 litres); with auxiliary tank, 89 Imp. gallons (404 litres). Oil tank above engine on rear engine bulkhead in fuselage centre-section. Total oil capacity 6.5 Imp. gallons (29.5 litres).

ACCOMMODATION.— *Search and Rescue*: crew of two with three rear "deck-chair" type seats for rescued personnel. *Ambulance*: pilot and medical orderly and accommodation for two stretcher cases. *Passenger transport, communications, etc.*: four or five persons including crew.

CONTROLS.—Main flying controls consist of a collective-pitch lever, control stick and foot pedals. In addition to the primary controls, a bias gear, operated by hand-wheels, relieves the load on the control stick, and assists in the longitudinal and lateral trim. A mechanical linkage is provided between the throttle and the collective pitch lever so that the throttle opening is automatically synchronised with increase or decrease of main rotor blade pitch. Over-ride settings of the throttle can be obtained by means of a twist-grip on the pitch lever. The engine clutch is automatic in operation. Provision is made for dual controls, the additional cyclic pitch control column and dual instrument panel being available as optional extras.

DIMENSIONS.—
- Main rotor diameter 48 ft. 6.7 in. (14.8 m.).
- Tail rotor diameter 9 ft. 7.3 in. (2.93 m.).
- Length (rotors at extreme positions) 61 ft. 1¼ in. (18.63 m.).
- Length (main rotor folded, tail rotor at min. position) 46 ft. 2 in. (14.1 m.).
- Height (tail rotor in extreme position) 14 ft. 7 in. (4.49 m.).
- Height (tail rotor in min. position) 12 ft 2 in. (3.71 m.).

WEIGHTS.—
- Basic weight (general purpose) 4,060 lb. (1,853 kg.).
- Basic weight (ambulance rôle) 4,138 lb. (1,881 kg.).
- Basic weight (search and rescue rôle) 4,150 lb. (1,887 kg.).
- Weight loaded (Military) 5,600 lb. (2,540 kg.).
- Weight loaded (Civil) 5,400 lb. (2,452 kg.). (Note: At time of writing application for increase in civil A.U.W. to 5,600 lb. (2,540 kg.) is before the British registration authorities).

PERFORMANCE (at 5,400 lb. = 2,452 kg. A.U.W. —I.C.A.N. conditions).—
- Max. speed (5 min. rating) (sea level), 127 m.p.h. (204 km.h.) at 287 rotor r.p.m.
- Max. speed (1 hr. rating) (at 2,000 ft. = 610 m.) 121 m.p.h. (195 km.h.) at 269 rotor r.p.m.
- Max. rich mixture cruising speed (at 2,000 ft. = 610 m.) 107 m.p.h. (172 km.h.) at 251 rotor r.p.m.
- Max. economical cruising speed (at 2,000 ft. = 610 m.) 91 m.p.h. (146 km.h.) at 242 rotor r.p.m.
- Max. vertical rate of climb (sea level) 420 ft./min. (128 m./min.).
- Max. climb at forward speed (5 min. power, sea level), 1,300 ft./min. at 60 m.p.h. I.A.S. (396 m./min. at 96 km.h.).
- Service ceiling 15,500 ft. (4,724 m.).
- Hovering ceiling (without ground effect) 4,000 ft. (1,220 m.).
- Max. still air range at normal load, 268 miles (430 km.).
- Max. still air range with auxiliary tank (total fuel 89 Imp. gal. = 404 litres) 368 miles (589 km.).

DE HAVILLAND

DE HAVILLAND HOLDINGS, LTD.

HEADQUARTERS: GREAT NAST HYDE, HATFIELD, HERTFORDSHIRE.

Directors: W. E. Nixon, F.C.I.S. (Chairman and Managing Director); A. F. Burke, O.B.E., M.Inst.T., F.R.S.A. (Deputy Chairman); Sir Geoffrey de Havilland, C.B.E., A.F.C., R.D.I., F.R.Ae.S., Hon.F.I.Ae.S.; F. E. N. St. Barbe; A. S. Kennedy, C.A.; Sir Ralph S. Sorley, K.C.B., O.B.E., D.S.C., D.F.C., F.R.Ae.S.; P. C. Garratt; and H. Buckingham.

In 1955, The de Havilland Aircraft Co., Ltd., the parent company of the de Havilland Enterprise, was renamed de Havilland Holdings, Ltd. At the same time, its aircraft manufacturing and trading activities were transferred to a wholly-owned subsidiary which then assumed the name of The de Havilland Aircraft Co., Ltd.

The three main operating subsidiaries in the United Kingdom are now:—

The de Havilland Aircraft Co., Ltd., Hatfield, Herts.

The de Havilland Engine Co., Ltd., Leavesden, Watford, Herts.

de Havilland Propellers Ltd., Hatfield Aerodrome, Herts.

Each of these companies is represented on the Board of de Havilland Holdings, Ltd., the latter being responsible for finance and for co-ordination of policy.

Associated Companies overseas are:—

The de Havilland Aircraft Pty., Ltd., P.O. Box 30, Bankstown, N.S.W., Australia.

The de Havilland Aircraft Company of New Zealand, Ltd., Rongotai, Wellington, New Zealand.

The de Havilland Aircraft of Canada, Ltd., Postal Station L, Toronto, Canada.

The de Havilland Aircraft Company of South Africa (Pty.) Ltd., P.O. Box 7105, Johannesburg, South Africa.

The de Havilland Aircraft Company (Rhodesia) Ltd., P.O. Box 329, Salisbury, S. Rhodesia.

de Havilland Aircraft Inc., Marine Terminal, La Guardia Airport, Flushing, New York, U.S.A.

In 1956 de Havilland Holdings, Ltd. acquired an interest in Saunders-Roe, Ltd., of East Cowes, Isle of Wight.

THE DE HAVILLAND AIRCRAFT CO., LTD.

ADMINISTRATION, DESIGN, EXPERIMENTAL AND ENGINEERING DEPARTMENTS, TECHNICAL SCHOOL, ETC.: HATFIELD AERODROME, HERTS.

PRODUCTION FACTORIES: HAWARDEN AERODROME, NEAR CHESTER, HATFIELD, HERTS., CHRISTCHURCH, HANTS., AND PORTSMOUTH, HANTS.

President: Sir Geoffrey de Havilland, C.B.E., A.F.C., R.D.I., F.R.Ae.S., Hon. F.I.Ae.S.

Chairman: W. E. Nixon, F.C.I.S.

Managing Director: A. F. Burke, O.B.E., M.Inst.T., F.R.S.A.

Other Directors: F. E. N. St. Barbe, R. E. Bishop, C.B.E., F.R.Ae.S., H. Povey, Hon. F.R.Ae.S., R. M. Clarkson, O.B.E., B.Sc., A.C.G.I., F.R.Ae.S. and A. S. Kennedy, C.A.

Secretary: W. D. Rennie.

The de Havilland Aircraft Company Limited was founded at Stag Lane, Edgware, in September, 1920, although the origins of the company go back to 1908 when Geoffrey de Havilland designed and built his first aeroplane. Divisions of the company for production of Gipsy engines and variable-pitch airscrews were formed in 1928 and 1935, and overseas companies were formed in 1927 (Australia) 1928 (Canada), 1929 (India), 1930 (South Africa) and 1939 (New Zealand).

Post-war civil production began with the Dove light transport, more than 500 of which have been built. This was followed in 1950 by the four-engined Heron feeder-liner which is in production and is in service in some twenty countries.

The company's most important post-war undertaking in the civil field is, however, the Comet jet airliner.

The Comet first flew in 1949 and, in 1952, a fleet of Comets entered service with B.O.A.C. After two years of operation involving some 30,000 hours of commercial service, the Comet 1 was withdrawn following two accidents in 1954.

After improvements in the light of knowledge gained from an extensive investigation by de Havilland and the R.A.E., an improved Comet 2 entered service with Royal Air Force Transport



An impression of the D.H. 121 Continental Airliner which has been ordered by British European Airways.

Command in June, 1956. In the following twenty-one months the R.A.F. fleet of ten Comets flew 10,000 hours in operational service.

The Comet 3, re-fitted with Rolls-Royce Avon RA.29 engines, continued its development flying for the Comet 4, the first of which made its maiden flight on April 27, 1958.

Comets are on order for B.O.A.C., B.E.A., East African Airways Corporation and Aerolineas Argentinas.

Developed during the war, but too late to see operational service, the Vampire single-seat jet fighter became the most widely-adopted fighter in the World, being supplied to the Air Forces of seventeen countries.

Later development of the basic Vampire led to the T. Mk. 11 side-by-side all-purpose jet trainer and the Venom day, night and naval fighter.

The latest de Havilland fighter now in production for the Royal Navy is the Sea Vixen, a two-seat day and night all-weather fighter powered by two Rolls-Royce Avon engines.

In February, 1958 B.E.A. announced their choice of the D.H. 121 design to fill their requirements for a short-range 600 m.p.h. jet airliner for service in 1963/64.

The development and production of the D.H. 121 as a private venture will be the responsibility of a new company formed for the purpose, to be known as The Aircraft Manufacturing Company Limited (Airco) (which see).

Details of the products of the Australian and Canadian de Havilland companies may be found in the "Australia" and "Canada" sections respectively.

The products of the de Havilland Engine Co., Ltd. are to be found in the "Engine" sections of this volume.

THE D.H. 121.

The D.H. 121 jet airliner has been chosen for service with British European Airways, which have placed an initial contract for 24 aircraft, with an option on 12 more. Development, production and marketing of the D.H. 121 will be handled by The Aircraft Manufacturing Co., Ltd., which has been formed especially for this purpose.

The D.H. 121 is intended to be essentially a continental or inter-city transport. Its design had not been finalised by the summer of 1958; but the broad B.E.A. requirement was for an aircraft to carry 70-80 standard-class passengers or 95-100 passengers in high-density seating, on stage lengths of up to about 1,000 miles (1,600 km.). Maximum cruising speed is to be more than 600 m.p.h. (965 km.h.).

Full advantage is to be taken of new techniques in airframe and engine design, to ensure a considerable measure of adaptability as regards stage length with capacity payload, and the ability to operate from runways 6,000 ft. (1,830 m.) in length. Operating costs are intended to be comparable with those of improved turboprop-powered aircraft that could be produced for service in 1964.

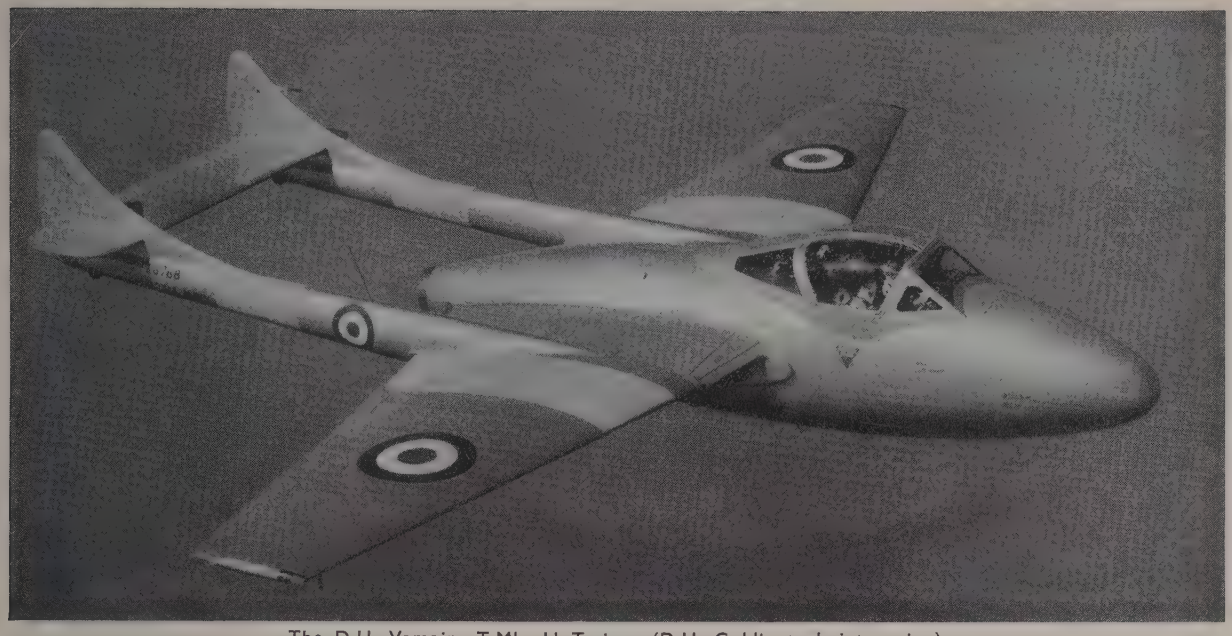
An artist's impression indicates that the D.H. 121 will have sweptback low-set wings mounted well back on the fuselage, with a T-type tail unit. It will be powered by three Rolls-Royce R.B. 141 by-pass turbojets of about 12,000 lb. (5,445 kg.) s.t. each, mounted above and on each side of the rear fuselage. It has been stated to be smaller than a Comet, and the short-range version will probably have a loaded weight of about 110,000 lb. (49,900 kg.).

THE D.H. 115 VAMPIRE TRAINER.

Development of a trainer version of the Vampire jet fighter was undertaken by the de Havilland company as a private venture. Under the designations Vampire T. Mk. 11 and Sea Vampire T. Mk. 22, the trainer, one of the first to feature the principle of side-by-side seating for instructor and pupil, has been adopted as the standard advanced trainer of the



The D.H. Sea Vampire T. Mk. 20 Trainer (D.H. Goblin turbojet engine). *(J. D. Rawlings).*



The D.H. Vampire T.Mk. 11 Trainer (D.H. Goblin turbojet engine).

Royal Air Force and the Royal Navy. It is also in service, as the Vampire T. Mk. 55, in the air forces of Australia, Burma, Chile, Egypt, Finland, India, Indonesia, Iraq, Lebanon, New Zealand, Portugal, South Africa, Rhodesia, Sweden, Switzerland, Venezuela, Ireland, Japan, Jordan and Syria.

The cabin is pressurized to a differential of 3 lb./sq. in., and is entered through a rearward-opening hood. All essential cockpit controls are duplicated.

The nose-cap hinges up to give access to certain equipment located in the forward fuselage, including a ciné-gun, radio, batteries and oxygen bottles. The normal Vampire armament of four 20 mm. cannon is retained in the fuselage belly. Rockets and bombs may also be carried.

DIMENSIONS.—
Span 38 ft. 0 in. (11.59 m.).
Length 34 ft. 6½ in. (10.51 m.).
Wing area 261 sq. ft. (24.25 m.²).

WEIGHTS.—
Weight loaded (clean) 11,150 lb. (5,060 kg.).
Weight loaded (with two 100 Imp. gal. =455 litre drop tanks) 12,920 lb. (5,860 kg.).

PERFORMANCE (Clean).—
Max. speed at S/L. 538 m.p.h. (866 km.h.).
Max. speed at 20,000 ft. (6,100 m.) 549 m.p.h. (885 km.h.).
Max. speed at 40,000 ft. (12,200 m.) 521 m.p.h. (839 km.h.).
Initial rate of climb 4,500 ft./min. (22.8 m./sec.).
Climb to 20,000 ft. (6,100 m.) 5.6 min.
Climb to 40,000 ft. (12,200 m.) 16.3 min.
Still air range without external equipment 623 miles (955 km.) at 300 m.p.h. (480 km.h.) at 20,000 ft. (6,100 m.) and 853 miles (1,370 km.) at 403 m.p.h. (650 km.h.) at 40,000 ft. (12,200 m.).
Take-off distance to 50 ft. (15.25 m.) 910 yds. (832 m.).
Landing distance from 50 ft. (15.25 m.) 1,180 yds. (1,080 m.).
Limiting Mach No without external equipment at high altitudes 0.815.

THE D.H. 114 HERON.

The Heron is now in service in twenty countries. The standard Heron airliner carries 14-17 passengers and the executive model has luxurious appointments for six-eight passengers.

The original Heron Series 1 with a fixed tricycle landing gear is no longer in production, having been superseded by the Heron Series 2 with a retractable tricycle landing gear.

Among the airlines and other operators which have taken delivery of Herons are New Zealand National Airways; Braathen's S.A.F.E. (Norway); Transportes Aereos Salvador (Brazil); Butler Air Transport (Australia); U.A.T. (France); Garuda Indonesian Airways; Jersey Airlines; PLUNA (Uruguay); Japan Air Lines; British European Airways; Turkish Airlines; Indian Airlines; West African Airways; Silver City Airways; Portuguese Ministry of Colonies; South African Air Force; Bahamas Airways; Cambrian Airways; AVIACO (Spain); Illini Airlines (U.S.A.); the West German Air Force and the Royal Iraq Air Force. In addition, a number of Herons are privately owned.

Three specially-equipped Heron Series 2 aircraft form the fixed-wing equipment of The Queen's Flight.

A full description of the Heron Series 1 has appeared in earlier editions of "All the World's Aircraft." The following data applies specifically to the Heron Series 2 :—

TYPE.—Four-engined Feeder-line or Executive Transport.

WINGS.—Low-wing cantilever monoplane. Aspect ratio 10.5. Light alloy structure with light alloy sheet skin. Goodyear pulsating-boot leading-edge de-icing. Ailerons in outer wing panels and trailing-edge flaps inboard in three pieces each side. Ailerons and flaps have metal frames and fabric covering. Flaps pneumatically-operated. Gross wing area 499 sq. ft. (46.4 m.²).

FUSELAGE.—Light alloy monocoque structure. Wing centre-section spar integral with fuselage. Main cabin floor of sandwich construction, stressed for freight carrying.

TAIL UNIT.—Cantilever monoplane type. Metal frames with fixed surfaces metal-covered and movable surfaces fabric-covered. Tailplane span 21 ft. 0 in. (6.4 m.).



The D.H. Heron Series 2 Light Transport (four 250 h.p. D.H. Gipsy Queen 30 Mk. 2 engines).



The D.H. Heron Series 2 Light Transport as supplied to the German Air Force.

LANDING GEAR.—Retractable tricycle type. Pneumatically-operated. Each main leg has rubber shock absorbers. Nosewheel has an oleo-pneumatic shock-absorber and is castoring and self-centering. Pneumatic brake operation. Track 16 ft. 8 in. (5.1 m.).

POWER PLANT.—Four 250 h.p. D.H. Gipsy Queen 30 Mk. 2 six-cylinder in-line air-cooled direct-drive unsupercharged engines. All engines on their bearers are interchangeable. D.H. 2/1000/2 bracket-type constant-speed two-blade airscrews, diameter 7 ft. (2.14 m.), feathering optional. Bag-type fuel tanks in each wing. Maximum fuel capacity 412 Imp. gallons (1,873 litres).

ACCOMMODATION.—Crew of two side-by-side in separate cockpit forward. Main passenger accommodation normally arranged for fourteen passengers in single seats each side of central aisle, with toilet at rear. Total cabin capacity 475 cub. ft. (13.45 m.³). Luggage bay at rear, capacity 105 cub. ft. (2.97 m.³). Alternative accommodation for fifteen passengers, with smaller toilet compartment and rear luggage bay capacity 70 cub. ft. (1.98 m.³), or for 17 passengers with no toilet and rear luggage bay capacity 45 cub. ft. (1.27 m.³). In each arrangement there is a front luggage compartment, capacity 22 cub. ft. (0.623 m.³). Entrance at rear on port side. Headroom in cabin 5 ft. 8½ in. (1.77 m.).

EQUIPMENT.—Full radio, including Marconi AD97/108 transmitter-receiver, Marconi AD7092 or AD7092A Automatic Radio Compass, and Standard STR9X V.H.F. Provision for Marconi blind-approach equipment, standard STR12 V.H.F. or Murphy MR60B V.H.F. radio, and Sperry A.L.Ia. autopilot.

DIMENSIONS.—
Span 71 ft. 6 in. (21.8 m.).
Length 48 ft. 6 in. (14.8 m.).
Height 15 ft. 7 in. (4.75 m.).

WEIGHTS.—
Tare weight (incl. radio) 8,484 lb. (3,848 kg.).
Crew (2) 330 lb. (150 kg.).
Fuel (typical case) for 400 mile (644 km.) stage with I.F.R. allowances (184 Imp. gal.=836 litres) 1,325 lb. (601 kg.).
Oil (15.3 Imp. gal.=69.6 litres) 138 lb. (63 kg.).
Payload 3,223 lb. (1,462 kg.).
Weight loaded 13,500 lb. (6,124 kg.).

PERFORMANCE. —
Cruising speed at 8,000 ft. (2,440 m.) at 65% METO power 183 m.p.h. (295 km.h.).
Weak mixture cruise at 3,000 ft. (915 m.) 191 m.p.h. (307 km.h.).
Rate of climb at S/L. 1,075 ft./min. (5.47 m./sec.).
Rate of climb at S/L. on three engines 620 ft./min. (3.14 m./sec.).
T.O. distance to 50 ft. (15.2 m.), hard runway, airline method 2,425 ft. (740 m.).
T.O. distance to 50 ft. (15.2 m.) with one engine cut at safety speed 2,875 ft. (875 m.).
Landing distance from 50 ft. (15.2 m.) 2,065 ft. (630 m.).

THE D.H. 112 SEA VENOM.

The Sea Venom is a two-seat naval all-weather fighter which was evolved from the Venom N.F. 2 two-seat night and all-weather land fighter which, in turn, was developed from the original single-seat Venom day fighter and fighter-bomber.

The Sea Venom has power folding wings, catapult and arrester gear, is powered by a D.H. Ghost engine and has a fixed armament of four 20 mm. cannon.

The Venom has been illustrated and described in previous editions. The following are the principal versions of the Sea Venom :—

Sea Venom F. (A.W.) Mk. 20. Naval version of the Venom N.F. Mk. 2, in service with the Royal Navy as a two-seat all-weather fighter. Fitted with power-folding wings, catapult gear and arrester gear.

Sea Venom F. (A.W.) Mk. 21. Improved Mk. 20 with special combat equipment, power-jettisonable clear vision hood and power-operated controls. Fitted with two lightweight Martin-Baker Mk. 4 ejector seats of latest fully-automatic type. In service in the Royal Navy.

Sea Venom F. (A.W.) Mk. 22. Latest version. More powerful version of Ghost engine.

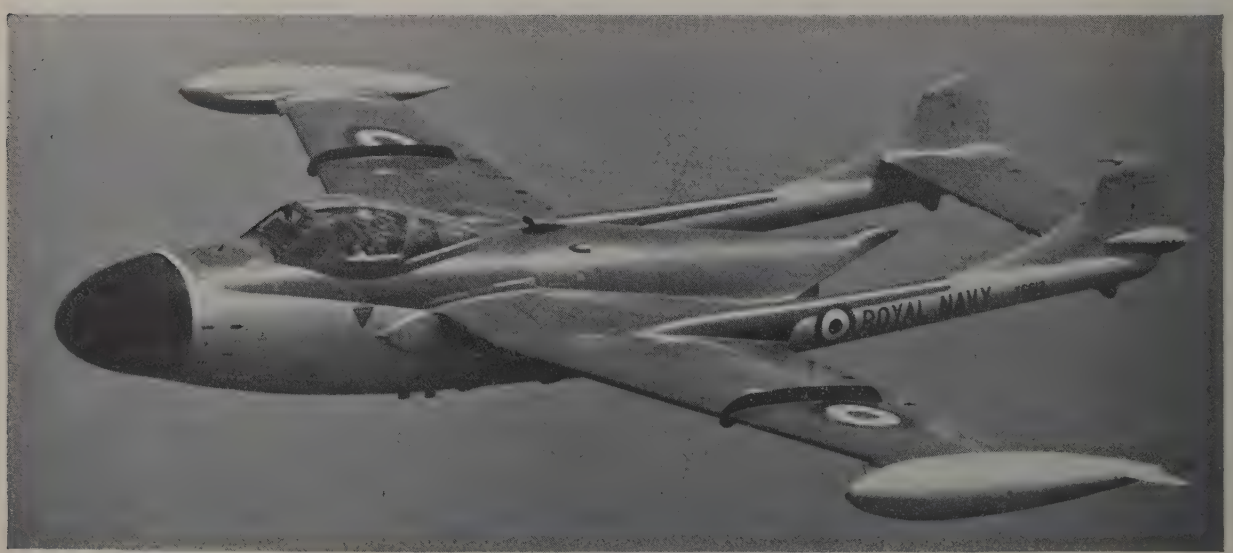
Sea Venom Mk. 52. Export version of Mk. 20 for French Navy. Built under licence in France by Sud-Aviation in single-seat and two-seat versions and named "Aquilon." Powered by Fiat-built D.H. Ghost 48 engine. First production Aquilon flew on March 25, 1954.

Sea Venom Mk. 53. Export version of Mk. 21 for Royal Australian Navy.

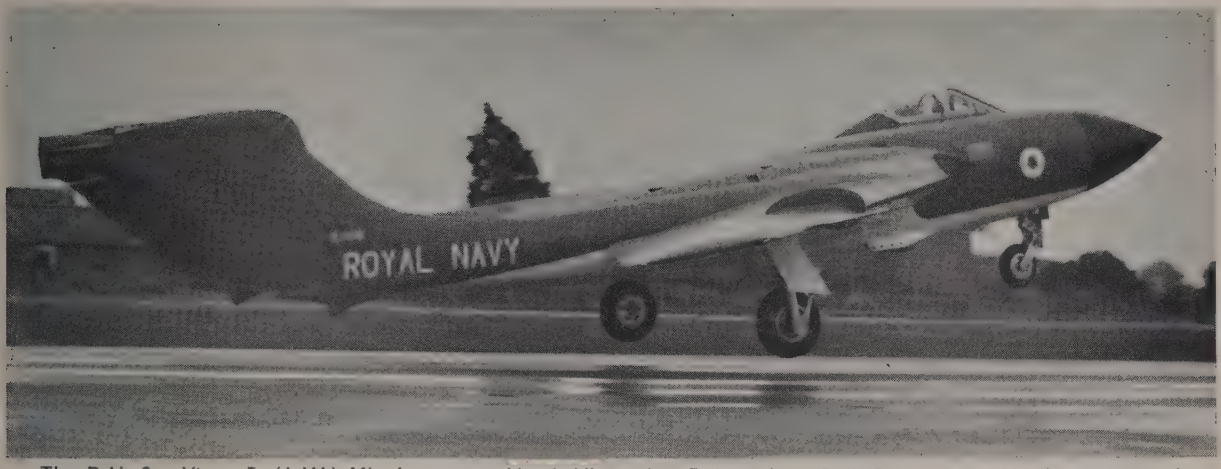
DIMENSIONS.—
Span 41 ft. 9 in. (12.7 m.).
Length (F.B. Mk 4) 33 ft. (10 m.)
Length (Sea Venom Mk. 21) 35 ft. 3 in. (10.7 m.).

THE D.H. 110 SEA VIXEN.

The Sea Vixen is a two-seat day and night all-weather fighter which successfully completed its carrier trials in April, 1956 and is in production for the Royal Navy at de Havilland's Christchurch works. The production order was placed



The D.H. Sea Venom F. (A.W.) Mk. 22 two-seat Naval All-weather Fighter (D.H. Ghost turbojet engine).



The D.H. Sea Vixen F. (A.W.) Mk. 1 two-seat Naval All-weather Fighter (two Rolls-Royce Avon 200 Series engines).

in January, 1955. It is powered by two Rolls-Royce Avon turbojet engines, can dive at supersonic speed, and is equipped with the latest electronic combat and navigational aids. Its armament includes de Havilland Firestreak infra-red guided weapons, and 28 2-in. air-to-air rockets in two batteries carried internally on retractable racks in the bottom of the fuselage.

Production Sea Vixen FAW. Mk. 1 has a wing probe for flight refuelling.

The first fully-developed Sea Vixen with power-folding wings, long-stroke landing gear and other changes flew on March 20, 1957, and the following details apply to this version :—

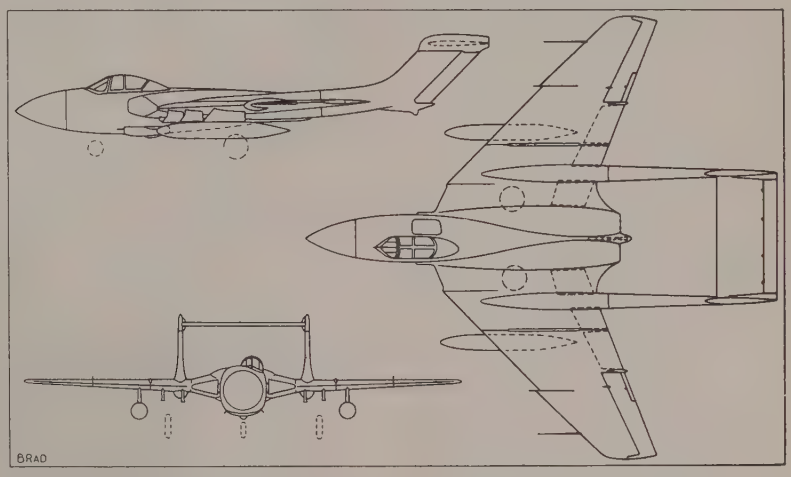
TYPE.—Two-seat Naval All-weather fighter.

WINGS.—Cantilever mid-wing monoplane. Sharply-swept wings fold hydraulically upward and inward through 110°. All-metal structure making extensive use of machined wing skins. Deeply-cambered leading-edges outboard of wing fences. Large Fowler-type flaps in sections on each side of tail booms are linked with tailplane. As flaps extend, rear portion of tailplane is deflected upward to cancel resulting trim change. Ailerons actuated by Hobson tandem-piston jacks.

NACELLE.—All-metal monocoque structure. Pointed nose section containing radar scanner hinges to starboard to reduce stowage length and for maintenance. Hydraulically-operated air-brake under centre of nacelle.

TAIL BOOMS.—All-metal structures of elliptical section, built integrally with fins.

TAIL UNIT.—All-metal centilever structure. Twin fins integral with tail booms. Twin rudders. All-moving "slab" tailplane mounted between top of fins, with variable



The D.H. Sea Vixen F. (A.W.) Mk. 1 Naval All-weather Fighter.

gear ratio. When "flaps down" is selected, rear portion of tailplane is unlocked from front portion and deflected up to cancel trim change due to flap extension. Rudders and tailplane operated by Hobson tandem-piston jacks.

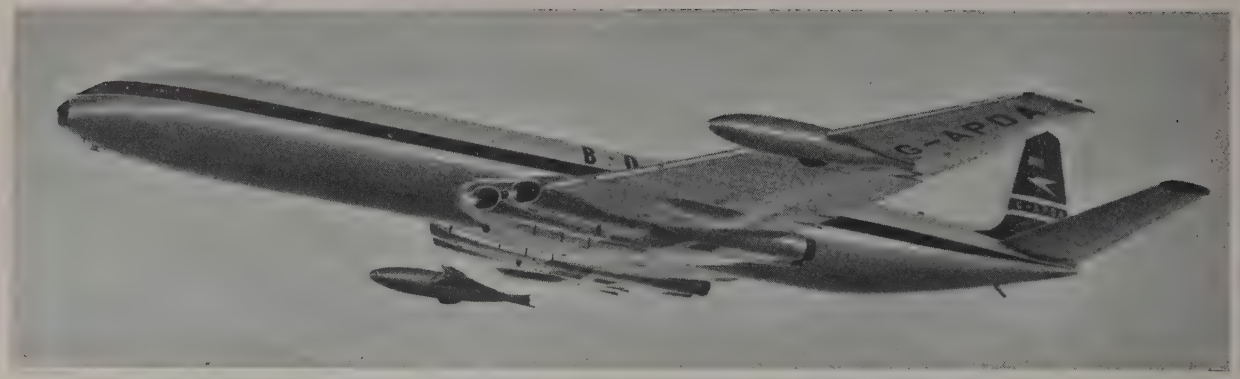
LANDING GEAR.—Retractable tricycle type. Long-stroke shock-absorbers. Hydraulic actuation. Steerable nose-wheel. Dunlop "Maxaret" anti-skid brakes. Tubeless tyres. Main wheel doors close when wheels down. Hydraulically-operated sting-type arrester hook under and between engine tailpipes. Wheel track 17 ft. 2½ in. (5.22 m.).

POWER PLANT.—Two Rolls-Royce Avon turbojet engines side-by-side in rear of nacelle, in fireproof bays. All skin above engines made up of removable access panels. Fuel in tanks between engine air intake ducts and in wings. Two 150 Imp. gallon (682 litre) auxiliary tanks can be carried under wings. Flight refuelling equipment is fitted.

ACCOMMODATION.—Crew of two. Pilot under offset canopy to port, with Vee type windscreen fitted with knife-edge for rain shedding. Observer totally enclosed in nacelle to starboard. Pressurised and air-



The D.H. Sea Vixen F. (A.W.) Mk. 1 two-seat Naval All-weather Fighter (two Rolls-Royce Avon 200 Series engines).



The D.H. Comet 4 Airliner (four Rolls-Royce Avon RA.29 turbojet engines).

conditioned cockpits. Martin-Baker Mk. 4 lightweight ejection seats.

ARMAMENT.—With two auxiliary fuel tanks, any of the following loads can be carried on underwing pylons: four de Havilland Firestreak missiles; two Firestreaks and 48 2-in rockets in two packs; four 500 lb. bombs; two Firestreaks and two 500 lb. bombs; two 500 lb. bombs and two clusters of six rockets each; four clusters of six 3-in air-to-surface rockets; or 96 2-in. air-to-air rockets in four packs. No guns are fitted, but 28 2-in. rockets are carried on retractable racks in the bottom of the fuselage.

DIMENSIONS.—
Span 50 ft. 0 in. (15.24 m.).
Length 53 ft. 6½ in. (16.31 m.).
Length (nose folded) 50 ft. 2½ in. (15.30 m.).
Height approx. 11 ft. (3.35 m.).
Width, wings folded, 22 ft. 3 in. (6.78 m.).
Height, wings folded, 14 ft. 11½ in. (4.55 m.).

WEIGHTS AND PERFORMANCE.—
No details available.

THE D.H. 106 COMET.

The Comet is now offered in three forms to cover differing operational rôles, the long-range Intercontinental Comet 4, the short and medium-range Continental Comet 4B and the Intermediate Comet 4C. All marks of Comet are fitted with four Rolls-Royce Avon RA.29 engines developing 10,500 lb. (4,767 kg.) of thrust.

The Comet design incorporates all the improvements accumulated in eight years of Comet development and operation, including 30,000 hours of airline flying and over 10,300 hours of service flying with the Royal Air Force Transport Command and Royal Canadian Air Force.

Deliveries of Comet 4's to B.O.A.C., who have 19 on order, began in 1958. Other Comet orders are for six Comet 4B's for B.E.A., two Comet 4's for East African Airways and six Comet 4's for Aerolineas Argentinas.

Brief details of the Civil versions of the Comet follow.

Comet 2E. Two Rolls-Royce Avon RA.9 turbojets (7,330 lb. = 3,320 kg. s.t.) in inboard nacelles; two Avon RA.29 turbojets (10,500 lb. = 4,767 kg. s.t.) in outboard nacelles. Two specially modified for B.O.A.C. to enable the airline's crews to build up experience with the RA.29 engines, of the type which will power the Comet 4. Delivered to B.O.A.C. in August, 1957 and accumulated 3,200 hours of flying by mid-April, 1958.

Comet 3. Four Rolls-Royce Avon RA.29 turbojet engines (10,500 lb.=4,767 kg. s.t. each). Development prototype for Comet 4. First flight on July 19, 1954. Originally had Avon RA.26 turbojets. Re-engined in February, 1957, to Comet 4 standard, thus enabling it to accomplish something like 80 per cent. of test flying necessary to obtain a C. of A. for the Comet 4. Now flying as Comet 3B.

Comet 3B. This is the Comet 3 with span reduced by 7 ft. (2.14 m.) as development prototype for Comet 4B. First flew on August 21, 1958.

Comet 4. Four Rolls-Royce Avon RA.29 turbojet engines (10,500 lb.=4,767 kg. s.t. each). Differs from the Series 3 in having a redesigned fuselage, increased power, reduced fuel consumption and increased tankage, resulting in improved range/payload capabilities. The Comet 4 will carry 60 first class passengers (capacity payload of 16,720 lb.=7,598 kg.) over a stage length of 3,000 statute miles (4,828 km.), allowing for reserves for climb, descent, head-winds, stand-off and diversions. Alternatively, it will carry 76 tourist class passengers (capacity payload of 19,361 lb. (8,782 kg.) over a stage length of 2,700 statute miles (4,345 km.) with reserves. First Comet 4 flew on April 27, 1958 and initial deliveries will be made in the latter part of 1958. Nineteen ordered by B.O.A.C., two by East African Airways Corporation and six by Aerolineas Argentinas.

Comet 4B. A medium-range version of the Comet 4 to carry 84-100 passengers over stages of 300 to 2,000 miles (480-3,220 km.). Fuselage lengthened by 6 ft. 6 in. (1.98 m.), wing span reduced by 7 ft. (2.14 m.) to permit higher cruising speed at lower altitudes. Wing nacelle fuel tanks deleted. Six ordered by B.E.A. for delivery in 1960.

Comet 4C. Announced in November, 1957, the Intermediate Comet 4C has the longer fuselage of the Comet 4B, accommodating 84-100 passengers, and the full-span wings of the Comet 4. It thus combines the superior operating economics of the Comet 4B with a payload-range capability only slightly short of that of the Comet 4, and a similar ability to operate from airfields of moderate size.

In addition, the following military versions of the Comet exist:—

Comet 1A. Four D.H. Ghost 50 Mk. 2 engines. Two delivered to R.C.A.F. in May, 1953. Returned to England for extensive modification and flown back to Canada in 1957.

Comet 2. Four Rolls-Royce Avon Mk. 118 engines. Structurally unmodified. Being used for unspecified special duties by the Royal Air Force.



The D.H. Comet 4 Airliner (four Rolls-Royce Avon RA.29 turbojet engines).

Comet T. Mk. 2. Four Rolls-Royce Avon Mk. 117 turbojets (7,300 lb. = 3,311 kg. s.t. each). Re-designed fuselage. A.U.W. 120,000 lb. (54,433 kg.). Two supplied to R.A.F. Transport Command for crew training.

Comet C. Mk. 2. Generally similar to T. Mk. 2. Long-range mixed passenger/freight transport with strengthened cargo floor forward and 44 backward-facing seats aft of centre-section. Pressurised to operate at 45,000 ft. (13,725 m.). Eight in service with R.A.F. Transport Command.

Details of the main features and performance of the Comet 4, 4B and 4C are as follows.

TYPE.—Four-engined Jet Airliner.

WINGS (Series 4 and 4C).—Low-wing cantilever monoplane with moderate sweepback, with two jet engines accommodated in each stub-wing, passing through the front and rear spar webs. Integral and bag-type fuel tanks and thermal de-icing. Air brakes are fitted. Plain flaps outboard of the engines and split flaps inboard, with hydraulic operation. Extensive use of Redux metal-to-metal bonding. Chord 29 ft. 6 in. (9.0 m.) at root, 6 ft. 9 in. (2.06 m.) at tip. Gross wing area 2,121 sq. ft. (197 m.²).

WINGS (Series 4B).—Basically as for Comet 4, but with reduced span. Aspect ratio 5.65. Gross wing area 2,066 sq. ft. (191.94 m.²).

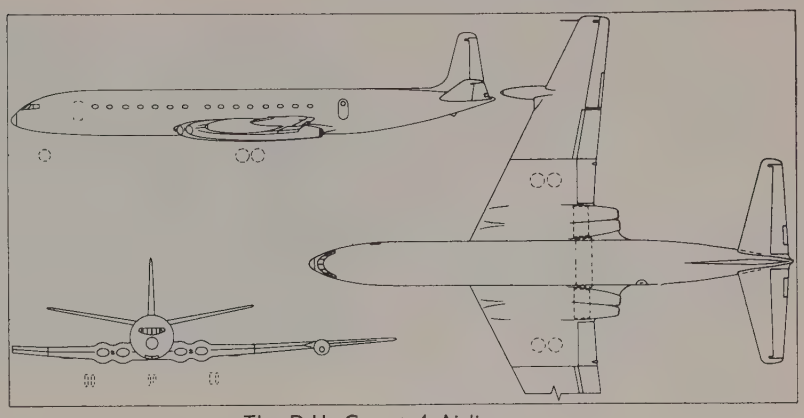
FUSELAGE.—Of circular cross section, 10 ft. (3.05 m.) in diameter throughout length of cabin. A pressure dome seals the aft end of the cabin. Redux bonding used extensively.

TAIL UNIT.—Cantilever monoplane tailplane and single fin and rudder. Tailplane span 47 ft. 5 in. (14.45 m.).

LANDING GEAR.—Retractable tricycle type of de Havilland design. Each main unit carries a four-wheel bogie retracting outwards into wings. Doors retract when undercarriage is down. Twin-wheel nose unit is steerable and retracts backwards into fuselage. Hydraulic retraction. Wheel track (shock-strut centres) 28 ft. 2 in. (8.58 m.). Wheel base (shock-strut centres) Comet 4 46 ft. 8 in. (14.22 m.).

POWER PLANT.—Four Rolls-Royce Avon RA.29 Mk. 524 turbojet engines (10,500 lb. = 4,767 kg. s.t. each) fitted with jet-noise suppressors and reverse-thrust units. Hinged panels below wings expose whole installations for easy servicing from ground. Quickly-detachable air intake and tail pipe connections and special disconnect-joints in engine control connecting rods. Installation is split into three temperature zones, each zone being separated by fire-proof bulkhead and having its own ventilators and fire-extinguishing system. Fuel in integral and flexible bag-type wing tanks, flexible bag tanks in centre-section and projecting leading-edge tanks (Comet 4 only) with pressure refuelling. Fuel capacity 8,860 Imp. gallons (40,277 litres) in Comet 4, 7,890 Imp. gallons (35,868 litres) in Comet 4B.

ACCOMMODATION (Series 4).—Flight deck forward, with accommodation for two pilots with full dual control, flight engineer, and radio-operator/navigator. Seating capacity 60/76 passengers. Flight deck, cabin and freight compartments pressurised to 8¾ lb./sq. in. (0.6 kg./cm.²) by air tapped from the engine compressors, giving a cabin altitude of 8,000 ft. (2,436 m.) when the aircraft is at 40,000 ft. (12,120 m.). Cabin 55 ft. 10 in. long, max. 9 ft. 9 in. wide and max. 6 ft. 6 in. high (17.01 × 2.96 × 1.98 m.). Galley, toilet, wardrobe and dressing amenities. Main passenger door in port side at end of cabin, and crew door forward in starboard side; both open inwards and measure 4 ft. 8 in. × 2 ft. 6 in. (1.43 m. × 0.761 m.). Freight capacities: rear hold floor 155 cub. ft. (4.387 m.³); rear hold (under floor) 240 cub. ft. (6.792 m.³); front hold (below floor) 150 cub. ft. (4.245 m.³).



The D.H. Comet 4 Airliner.

ACCOMMODATION (Series 4B and 4C).—Basically as Comet 4, but fuselage lengthened by 78 in. (1.98 m.) to accommodate 84 first class or 100 tourist passengers.

DIMENSIONS (Series 4).—
Span 114 ft. 9 in. (35 m.).
Length 111 ft. 6 in. (33.99 m.).
Height (on ground—over fin) 28 ft. 5 in. (8.66 m.).

DIMENSIONS (Series 4B).—
Span 107 ft. 9½ in. (32.86 m.).
Length 118 ft. (35.97 m.).
Height 28 ft. 5 in. (8.66 m.).

DIMENSIONS (Series 4C).—
Span 114 ft. 9 in. (35 m.).
Length 118 ft. (35.97 m.).
Height 28 ft. 5 in. (8.66 m.).

WEIGHTS (Series 4).—
Basic operational weight 72,595 lb. (32,930 kg.).
Capacity payload (60 seats) 16,800 lb. (7,620 kg.).
Capacity payload (76 seats) 19,455 lb. (8,824 kg.).
Weight loaded 156,000 lb. (70,760 kg.).
Max. landing weight 113,000 lb. (51,260 kg.).

WEIGHTS (Series 4B).—
Basic operational weight 73,816 lb. (33,482 kg.).
Max. payload 21,968 lb. (9,964 kg.).
Max. loaded weight 152,500 lb. (69,235 kg.).
Max. landing weight 118,500 lb. (53,750 kg.).

WEIGHTS (Series 4C).—
Basic operational weight 74,906 lb. (33,977 kg.).
Max. payload 21,785 lb. (9,880 kg.).
Max. loaded weight 156,000 lb. (70,760 kg.).
Max. landing weight 118,500 lb. (53,750 kg.).

PERFORMANCE (Series 4).—
Cruising speed 510 m.p.h. (818 km.h.).
Take-off field length at max. A.U.W. 6,380 ft. (1,945 m.).
Landing distance from 50 ft. (15.25 m.) 3,520 ft. (1,073 m.).
Range, still air, with 16,800 lb. (7,620 kg.) payload, with reserves, 3,150 miles (5,070 km.).

PERFORMANCE (Series 4B).—
Mean cruising speed at 23,500 ft. (7,160 m.) in I.S.A. conditions 532 m.p.h. (856 km.h.).
Take-off field length at max. A.U.W. 6,500 ft. (1,980 m.).
Range, still air, with max. payload, at mean cruising speed of 532 m.p.h. (856 km.h.), 1,900 miles (3,060 km.).

PERFORMANCE (Series 4C).—
Mean cruising speed at 33,000 ft. (10,060 m.) 509 m.p.h. (819 km.h.).
Take-off field length at max. A.U.W. 6,770 ft. (2,065 m.).
Landing distance from 50 ft. (15.25 m.) 6,820 ft. (2,080 m.).
Range, still air with 21,755 lb. (9,866 kg.) payload, with reserves 2,450 miles (3,943 km.).

THE D.H. 104 DOVE.

R.A.F. Name: Devon.
Royal Navy Name: Sea Devon.

More than 500 Dove light transports are now operating in a variety of rôles all over the World. The standard commercial model has accommodation for eight/eleven passengers, but variants have been designed for survey, pest-control, executive and ambulance duties.

The current basic civil versions of the Dove are as follows:—

Series 5. Two 380 h.p. D.H. Gipsy Queen 70 Mk. 2 engines. Installation of this engine requires no modifications to the standard Dove engine bearer structure, pipe lines and control runs. Twenty per cent. increase in pay-load over 500 mile (800 km.) stage as compared with the earlier Series 1.

Series 6. Same as Series 5 but with special executive interior.

A full structural description of the Dove has appeared in previous editions of this work.

The military versions of the Dove are:—



A Comet T. Mk. 2 of R.A.F. Transport Command (four Rolls-Royce Avon Mk. 117 turbojet engines).

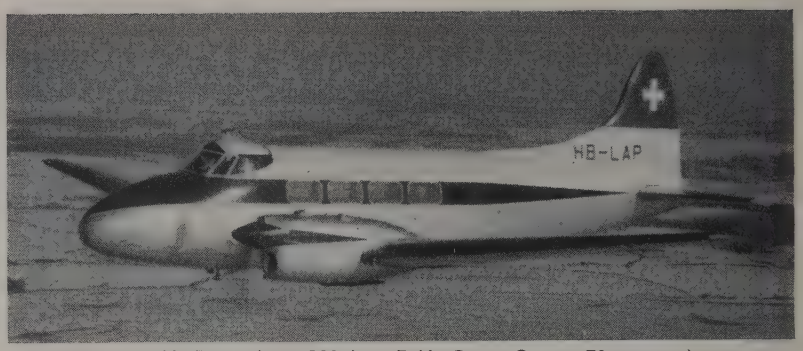
Devon C. Mk. 1. Two 380 h.p. D.H. Gipsy Queen 70 engines. Light communications aircraft in service with the Royal Air Force and the Royal New Zealand Air Force.

Sea Devon C. Mk. 20. Royal Navy version of the Devon C. Mk. 1.

DIMENSIONS.—
Span 57 ft. 0 in. (17.40 m.).
Length 39 ft. 3 in. (11.96 m.).
Height (over rudder) 13 ft. 4 in. (4.06 m.).

WEIGHTS AND LOADINGS (Series 5 and 6).—
Tare weight (including radio) 5,878 lb. (2,667 kg.).
Crew (2) 330 lb. (150 kg.).
Fuel (for 400 miles = 645 km.) 845 lb. (383 kg.).
Oil 84 lb. (38 kg.).
Payload 1,663 lb. (754 kg.).
Weight loaded 8,800 lb. (3,992 kg.).
Wing loading 26.3 lb./sq. ft. (128.2 kg./m.²).
Power loading 11.58 lb./h.p. (5.66 kg./h.p.).

PERFORMANCE (Series 5 and 6).—
Max. weak mixture cruising speed at 8,000 ft. (2,440 m.) 202 m.p.h. (325 km.h.).
Cruising speed at 60% M.E.T.O. power at 8,000 ft. (2,440 m.). 179 m.p.h. (288 km.h).
Rate of climb at sea level 920 ft./min. (4.67 m./sec.).
Rate of climb on one engine at M.E.T.O. power 220 ft./min. (1.12 m./sec.).
Stage length with 1,500 lb. (680 kg.) payload without extra tanks under V.F.R. conditions 660 miles (1,050 km.).
Take-off distance to 50 ft. (15 m.) 810 yds. (740 m.).
Landing distance from 50 ft. (15 m.) 640 yds. (585 m.).
Fuel consumption at cruising speed 27.3 Imp. gallons per hour (124 litres per hour) (6.55 m.p.g. = 2.32 km. per litre).
Fuel consumption at max. weak mixture cruising speed 35 Imp. gallons per hour (159 litres per hour) (5.77 m.p.g. = 2.04 km per litre).



The D.H. Dove (two 380 h.p. D.H. Gipsy Queen 70 engines).

THE D.H.C. 1 CHIPMUNK Mk. 23

The Chipmunk primary trainer has been fully described in previous issues of this Annual. In 1958 de Havilland, in conjunction with Fison-Airwork, Ltd., produced an agricultural version of the Chipmunk known as the Mk. 23.

The Mk. 23, a conversion of the primary trainer, is a single-seater with a chemical hopper/tank of 1.4 cu. ft. (0.396 m.³) capacity occupying the space where the original front cockpit used to be. The pilot occupies the former rear cockpit, the seat of which has been raised, and a new windscreen with large flat glass panels and a sliding canopy with bulged sides are fitted. Fixed slots ahead of the ailerons and small wing-root spoilers have been added.

The Fiberglas tank is used for both liquids and solids. For use with liquids a spray-bar, suspended from the rear spar over the full span, is fitted, while a special chute for dispensing solids can be mounted under the fuselage. Spray-bar and chute are quickly interchangeable.

The Mk. 23 is powered by a 145 h.p. D.H. Gipsy Major 10 engine which drives a special fine-pitch airscrew. With this installation the agricultural Chipmunk takes off in 200 yards (183 m.) at its all-up weight of 2,420 lb. (1,100 kg.) and carrying its certified hopper load of 560 lb. (254 kg.). Stalling speed with half flap—i.e. the spraying configuration—is 44 m.p.h. (70 km.h.) at full load. Landing light with full flap the stalling speed is reduced to 33 m.p.h. (53 km.h.).

EDGAR PERCIVAL

EDGAR PERCIVAL AIRCRAFT, LTD.

HEAD OFFICE AND WORKS: STAPLEFORD AERODROME, ROMFORD, ESSEX.

Edgar Percival, an Australian pilot and engineer, was the founder of the original Percival Aircraft Company in 1932. For this company he designed the well-known Percival Gull Series of aircraft, examples of which won The King's Cup in 1936, 1937, 1938 and 1955. Percival Gulls also made many notable long-distance flights before the 1939-45 war and a developed military form of the Gull, known as the Proctor, was produced in large numbers during the war.

Mr. Percival formed Edgar Percival Aircraft Ltd. to produce his latest design, the EP.9 general-purpose monoplane which is described hereafter.

THE EDGAR PERCIVAL EP.9.

The prototype of the EP.9 made its first flight on December 21, 1955. The first aircraft of a production batch of 100 flew on June 30, 1956.

The EP.9 is capable of fulfilling a number of different roles, for some of which specialised equipment is either built-in or can be easily installed. All models may be fitted with floats, ski or wheel landing gear.

By September, 1958, EP.9's were in service in Australia, New Zealand, Canada, North Africa, Germany, France, French West Africa and Tasmania. About half of the total sold were the six-seat passenger version with removable seats for freight-carrying.

Two EP.9's have also been evaluated by the British Army Air Corps for general liaison duties.

TYPE.—Single-engined General purpose monoplane.

WINGS.—High-wing braced monoplane. Wing section developed from a laminar flow section. Aspect ratio 8.31. Chord 5 ft. 3½ in. (1.61 m.). Dihedral 1°. Incidence 1°. Single-spar light alloy structure, with stressed skin covering. Light alloy stressed skin slotted flaps and slotted ailerons. Total area of ailerons 22.4 sq. ft. (2.08 m.²). Total area of flaps 29.6 sq. ft. (2.75 m.²). Gross wing area 227.6 sq. ft. (21.14 m.²).

FUSELAGE.—Welded steel-tube structure, fabric-covered.

TAIL UNIT.—Braced monoplane type. Light alloy structure with stressed skin covering. Single bracing rod each side from fin to tailplane. Areas: fin and rudder 25 sq. ft. (2.32 m.²), tailplane and elevators 42.8 sq. ft. (3.98 m.²). Tailplane span 14 ft. 0 in. (4.27 m.).

LANDING GEAR.—Fixed tail-wheel type. Edgar Percival rubber-in-compression shock absorbers. Goodyear wheels and Goodyear single plate disc brakes. Wheel track 10 ft. 6 in. (3.2 m.). Wheelbase 20 ft. 1 in. (6.1 m.).

POWER PLANT.—One 270 h.p. Lycoming GO-480-B1B six-cylinder horizontally-opposed air-cooled engine driving a Hartzell two-blade metal constant-speed airscrew. Fuel in two tanks in wing roots, each with capacity of 28 Imp. gallons (127 litres). Oil capacity 2½ Imp. gallons (11.3 litres).

ACCOMMODATION.—Enclosed cabin seating pilot and five passengers, or pilot, one passenger beside pilot and any one of various alternative loads in 185 cub. ft. (5.24 m.³) of usable space aft of front seats. Entrance doors to front seats on port and starboard sides. Entrance door to rear of cabin on port side, with large sideways-hingeing rear door for freight loading.

DIMENSIONS.—
Span 43 ft. 6 in. (13.26 m.).
Length 29 ft. 6 in. (8.99 m.).
Height 8 ft. 9 in. (2.67 m.).

WEIGHTS.—
Weight empty 2,010 lb. (910 kg.).
Weight loaded (normal) 3,550 lb. (1,612 kg.).
Max. loaded weight (non-agricultural) 3,700 lb. (1,680 kg.).
Weight loaded (agricultural category) 4,320 lb. (1,960 kg.).
Useful load (normal) for 350 mile (560 km.) range 1,238 lb. (762 kg.).
Useful load (normal) for 150 mile (240 km.) range 1,378 lb. (626 kg.).
Useful load (agricultural category) for 150 mile (240 km.) range 1,978 lb. (898 kg.).

PERFORMANCE (at 3,700 lb. = 1,680 kg. A.U.W.).—
Max. speed 146 m.p.h. (233.6 km.h.).
Max. continuous speed 142 m.p.h. (229 km.h.).
Econ. cruising speed 120 m.p.h. (193 km.h.).
Min. stalling speed 35 m.p.h. (56 km.h.).
Max. rate of climb 960 ft./min. (294 m./min.).
T.O. run, grass field, 5 m.p.h. (8 km.h.) wind 375 ft. (114 m.).
Take-off distance to 50 ft. (15.25 m.) in 5 m.p.h. (8 km.h.) wind 1,055 ft. (324 m.).
Landing distance from 50 ft. (15.25 m.) in 5 m.p.h. (8 km.h.) wind 1,005 ft. (306 m.).
Range 580 miles (934 km.).

PERFORMANCE (full load, agricultural category).—
Max. speed 144 m.p.h. (232 km.h.).
Cruising speed 126 m.p.h. (203 km.h.).
Econ. cruising speed 118 m.p.h. (189 km.h.).
Min. stalling speed 38 m.p.h. (61 km.h.).
Max. rate of climb 600 ft./min. (186 m./min.).



The Edgar Percival EP.9 (270 h.p. Lycoming GO-480 engine).

ELLIOTTS

ELLIOTTS OF NEWBURY, LTD.

HEAD OFFICE AND WORKS: ALBERT WORKS, NEWBURY, BERKS.

Directors: H. C. G. Buckingham (Managing), W. Goodyear, A. E. Gill, K. de V. Buckingham.

Elliotts of Newbury have been producing the world-famous Olympia sailplane in various versions since just after the war. First major development of the design was the Type 401, fitted with a new wing of laminar-flow section spanning 49 ft. 2½ in. (15.0 m.). This offered a considerable improvement at high speeds.

To achieve better performance in the low-speed range also, this prototype was further developed into the Type 402, which was similar except the wing span was increased to 55 ft. 9 in. (17.0 m.). This aircraft won second place in the 1956 British National Championships. and was followed by Type 403, similar except for an all-moving tail with anti-balance tabs.

Following many successful flights by the 403, Elliotts built a new prototype known as the Type 419, with a still larger span, and this sailplane flew for the first time on March 29, 1958. In the following month it set up a British national distance record of 315 miles (507 km.) and was flown subsequently by the British team in the 1958 World Gliding Championships.



The Elliotts 419 Series IV Olympia Sailplane (*Flight photograph*).

It is described hereafter, together with the Type 415, which is similar, but smaller in size.

THE ELLIOTTS 419 SERIES IV OLYMPIA.

TYPE.—Single-seat High-performance sailplane.

WINGS.—Cantilever high-wing monoplane. Wing section NACA 64^{3} 618 at root, modified 64^{4} 421 at tip. Aspect ratio 19.9. All-wood two-spar structure, covered with plywood outboard of ailerons, with fabric covering inboard. Frise-type ailerons. Airbrakes extend from slots above and below wing. Wing area 186 sq. ft. (17.28 m.²)

FUSELAGE.—Wooden structure, with plywood covering.

TAIL UNIT.—Cantilever monoplane type, of wood construction. Fin plywood-covered. Tailplane and rudder fabric-covered. All-moving tailplane with geared (2 : 1) anti-balance tab each side. Tailplane folds up to lie flat against fin for transport.

LANDING GEAR.—Small jettisonable two-wheel unit for launching. Large rubber-sprung landing skid under forward fuselage. Small tail-wheel carried on leaf-spring.

ACCOMMODATION.—Pilot only in roomy cockpit under detachable canopy. Full instrumentation. Oxygen installation.

DIMENSIONS.—
Span 62 ft. (18.9 m.).
Length 25 ft. (7.62 m.).

WEIGHT AND LOADING.
Weight empty 606 lb. (275 kg.).
Weight loaded 850 lb. (385 kg.).
Wing loading 4.4 lb./sq. ft. (21.5 kg./m.²).

PERFORMANCE (provisional).—
Min. sinking speed 1.84 ft./sec. (0.56 m./sec.) at 46 m.p.h. (74 km.h.).
Best gliding ratio 38 : 1 at 52 m.p.h. (84 km.h.).



The Elliotts 415 Olympia Sailplane (*Flight photograph*).

THE ELLIOTTS 415 OLYMPIA.

Basically similar to the 419, this sailplane has a reduced span, enabling it to meet the requirements of the international restricted class.

DIMENSIONS.—
Span 49 ft. 2 in. (15.0 m.).
Length 24 ft. 6 in. (7.47 m.).
Wing area 161 sq. ft. (14.96 m.²).

WEIGHTS. —
Weight empty 550 lb. (249 kg.).
Weight loaded 820 lb. (372 kg.).

PERFORMANCE (provisional).—
Best glide ratio 35 : 1.

ENGLISH ELECTRIC

THE ENGLISH ELECTRIC COMPANY LTD.

HEAD OFFICE: MARCONI HOUSE, STRAND, LONDON, W.C.2.

WORKS, AIRCRAFT DIVISION: PRESTON AND SAMLESBURY, LANCS.

Directors: Sir George H. Nelson, F.C.G.I., M.I.Mech.E., M.I.E.E. (Chairman), H. G. Nelson, M.I.C.E., M.I. Mech.E., M.I.E.E. (Managing Director), Sir Edward Crowe, K.C.M.G., P. Horsfall, Sir Charles P. Snow, C.B.E., Ph.D., Sir Edward Wilshaw, K.C.M.G., Sir John Woods, G.C.B., M.V.O., Lord Caldecote, D.S.C., Godfry Phillips and Sir Archibald F. Forbes, G.B.E.

Chief Engineer, Aircraft Division: F. W. Page, B.A., F.R.Ae.S.

Deputy Chief Engineer: R. F. Greasey, B.Sc.

Chief Designers: F. D. Crowe, B.Sc. (Eng.), A.F.R.Ae.S. and A. E. Ellison, A.M.I.Mech.E.

The English Electric Co., Ltd. was formed in 1918 by the amalgamation of Dick Kerr & Co., Ltd., of Preston; the Coventry Ordnance Works, Ltd., of Coventry; the Phoenix Dynamo Manufacturing Co., Ltd., of Bradford; Willans & Robinson, Ltd., of Rugby; and the Siemens Dynamo Works of Stafford. The first three companies mentioned had had considerable experience in aircraft design and construction, dating back in the case of the Coventry Ordnance Works to 1911. Dick Kerr and Phoenix Dynamo between them were the largest producers of seaplanes and flying-boats in World War I.

The then newly-formed English Electric Co., Ltd., retained an aircraft department and continued to build flying-boats of its own design until 1926.

Aircraft manufacture was resumed at Preston in 1938, and after the war, English Electric established its own technical and design organization, the first product of which was the Canberra twin-jet bomber. The Canberra is in production for the Royal Air Force both by English Electric and by Short Bros. & Harland, Ltd., has been supplied to the air forces of Ecuador, Venezuela, Peru and India, and has been ordered for the Royal New Zealand Air Force. A number have also gone to the Centre d'Essais en Vol in France.

The Canberra is also being built at the Australian Government factory at Fishermen's Bend, Melbourne, for the R.A.A.F., and in the United States by The Martin Company, under the U.S.A.F. designation B-57. For further details of the B-57 see under "Martin" (U.S.A.).

A total of more than 1,200 Canberras had been built throughout the World by the Spring of 1958.

Following the success of the Canberra, English Electric designed the P.1 fighter which is now in production for the Royal Air Force.

The company also announced in May, 1957 that it has formed a civil aircraft project design team at Warton aerodrome, near Preston, as an extension of the Aircraft Division's work, but no details of its civil projects are yet available.

Details of the Thunderbird surface-to-air guided missile for which the English Electric Guided Weapons Division at Luton and Stevenage have a large production contract, appear in the "Guided Missiles" section of this work.

THE ENGLISH ELECTRIC P.1 LIGHTNING.

The P.1 is in production for the Royal Air Force as a highly supersonic all-weather day and night interceptor which will be armed with de Havilland Firestreak air-to-air missiles. Two versions have been announced, as follows.

P.1A. Three prototypes only, each powered by two Armstrong Siddeley Sapphire turbojets. Two for intensive flying trials and one for structure testing to destruction in ground rig. First flight August 4, 1954.

P.1B. Extensively-redesigned version. Three prototypes and 20 pre-production aircraft will be of this type, which has also been ordered into series production. Two Rolls-Royce Avon turbojets with reheat. Napier Double Scorpion rocket pack optional. New air intake with

pointed centre-body and other changes. First flight April 4, 1957.

The P.1 had its origin in a specification for a manned supersonic research aircraft issued by the Ministry of Supply in 1947 under the designation E.R.103. English Electric submitted their proposal in 1949, having designed their project so that it would be capable of development into a fighter, and were awarded a prototype contract. In 1954 work began on re-engineering the P.1 as a complete "weapons system."

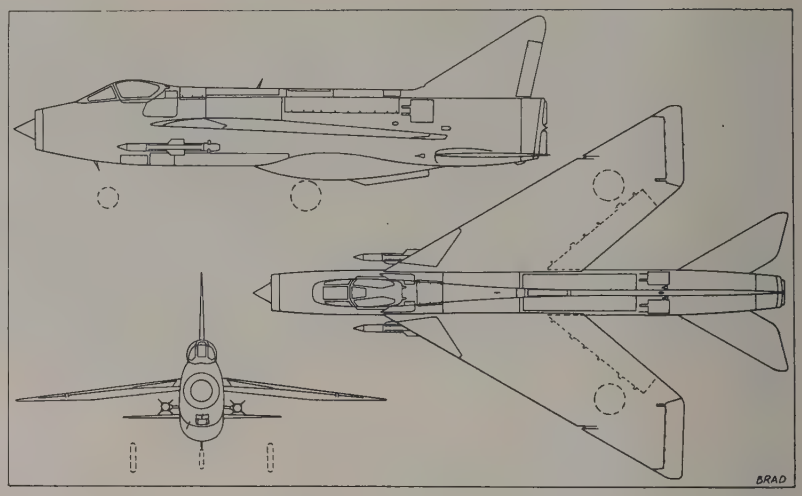
In 1950, the company built the first privately-owned transonic-supersonic wind tunnel in the country to assist in the development of the P.1, and Short Brothers and Harland Ltd. were given a contract for the S.B.5 research aircraft to test the proposed design at comparatively low speeds.

The original unarmed prototype P.1A flew on August 4, 1954, exceeding the speed of sound during its second flight without the pilot being aware of the fact. Soon afterwards it went supersonic in a climb and by April, 1957 the two flying prototypes had made more than 500 flights, in which supersonic speeds in level, climbing and turning flight were regarded as normal practice.

Subsequent modifications to the first prototype include the fitting of developed Sapphire turbojets with reheat, and an extended wing leading-edge near the tips, with conical camber to improve the operational ceiling and range at subsonic and low supersonic speeds.

The second prototype P.1A carries two 30 mm. Aden guns in its forward fuselage and additional operational equipment. A bulged fairing, for the alternative installation of a Napier Double Scorpion rocket motor or an external fuel tank, has been fitted under its rear fuselage.

The extended wing leading-edge and under-fuselage pack will be incorporated eventually on the P.1B, of which the first prototype flew on April 4, 1957. Two prototypes and each of the 20 pre-production aircraft of this series will be used for intensive development of a particular facet of supersonic interception, such as the navigation aids, radio, armament, automatic pilot, engines, radar, handling and operational trials.



The English Electric P.1B Lightning.

Air Marshal Sir Thomas Pike, A.O. C.-in-C. of Fighter Command, has said that the P.1 will be capable eventually of 1,500 m.p.h. (2,415 km.h.). It can cruise economically on one engine.

The following details apply to the P.1B prototype.

TYPE.—Single-seat Supersonic All-weather Interceptor.

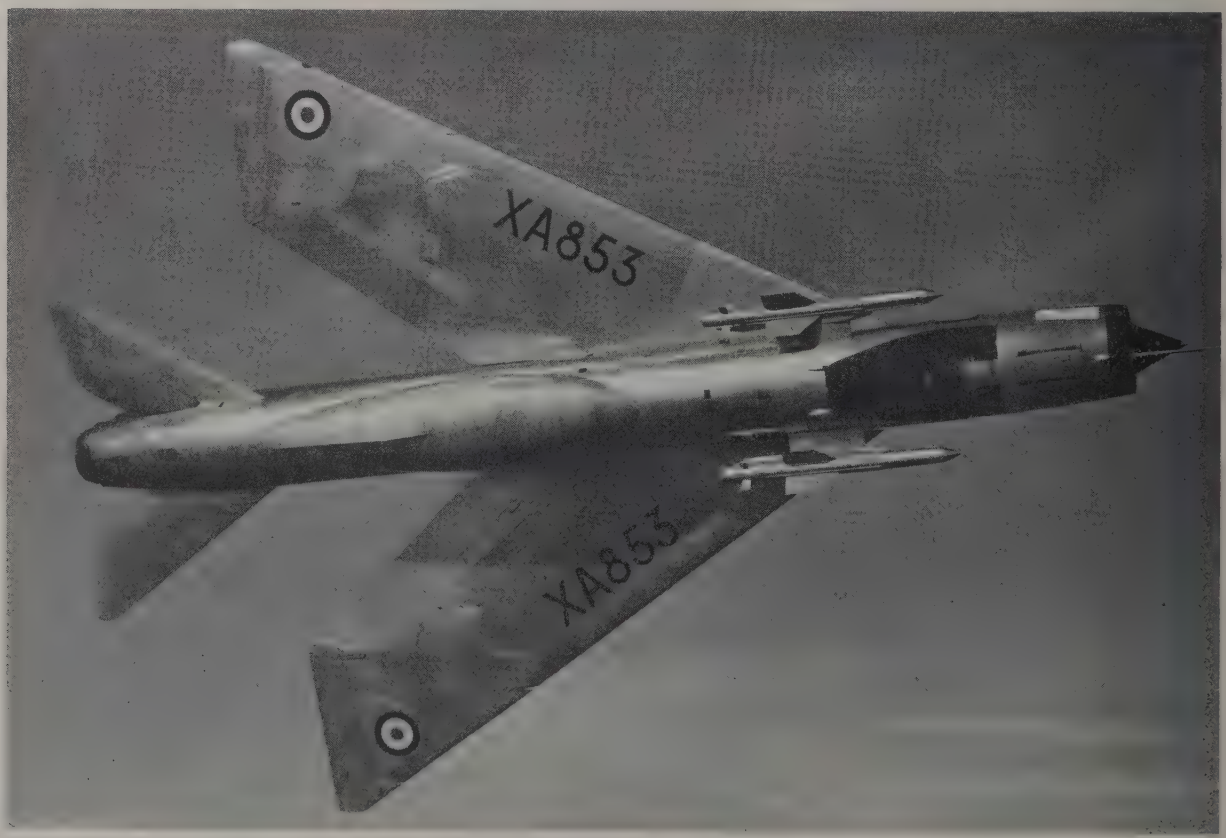
WINGS.—Cantilever mid-wing monoplane. Sweepback 60°. Thickness/chord ratio approximately 5%. All-metal five-spar structure. Powered ailerons, which extend across wing-tips at right-angles to fuselage, are horn-balanced on prototypes, but will be inset on production aircraft. Fore-and-aft notches in leading-edge in lieu of fences. Large split flaps.

FUSELAGE.—Parallel-section all-metal structure designed in full knowledge of the area rule. Air-brakes on upper part of fuselage near junction of fin leading-edge.

TAIL UNIT.—Cantilever monoplane type. All-metal structure. Low-set one-piece all-moving tailplane follows wing shape. Delta-shape fin and rudder, without trim-tab. Tailplane span 14 ft. 6 in. (4.42 m.).

LANDING GEAR.—Retractable tricycle type, of joint English Electric-British Messier design. Main units retract outwards into wings. Hydraulically-steerable nose-wheel, retracts forward into fuselage. Dunlop wheels, tyres and Maxaret brakes. Tyre pressure 280 lb./sq. in. (19.7 kg./cm.^{2}). Braking parachute housed in bottom of rear fuselage. Wheel track 12 ft. 9.3 in. (3.89 m.).

POWER PLANT.—Two Rolls-Royce Avon turbojet engines with reheat, staggered one above the other in the fuselage, and with variable-area nozzles. Lower engine is well forward of upper one. Optional installation of a Napier Double Scorpion rocket pack under fuselage. Integral fuel tanks in wings.



The English Electric P.1B Lightning All-weather Interceptor armed with two D.H. Firestreak missiles.



The English Electric P.1B Lightning All-weather Interceptor (two Rolls-Royce Avon RA.24 engines with reheat).

ACCOMMODATION.—Enclosed cockpit for pilot fitted with rearward-hingeing canopy and Martin-Baker Mk. 4 ejection seat. Cockpit pressurised and refrigerated.

ARMAMENT.—Two 30 mm. Aden cannon in fuselage, on each side of cockpit, and two de Havilland Firestreak air-to-air missiles on pylons projecting laterally from fuselage. Rocket, gun or camera packs can be substituted for missiles. Ferranti Airpass radar in air intake centre-body.

DIMENSIONS (P.1B).—
Span 34 ft. 10 in. (10.61 m.).
Length 50 ft. 0 in. (15.24 m.).
Height 17 ft. 6 in. (5.33 m.).

WEIGHTS AND PERFORMANCE.—
No details available.

THE ENGLISH ELECTRIC P.11.

The English Electric P.11 is an operational trainer version of the P.1B interceptor. It is generally similar to the P.1B, except that the front fuselage has been widened to accommodate two seats side-by-side. The full range of operational equipment is retained, and this implies the possibility of the P.11 being developed for two-seat combat duties.

Power plant of the P.11 comprises two Rolls-Royce Avon turbojets.

It was announced in July, 1958 that the P.11 has been ordered into production for service with the Royal Air Force.

THE ENGLISH ELECTRIC CANBERRA.

Designed originally to Specification B.3/45, the Canberra is powered by two Rolls-Royce Avon turbojet engines. The first prototype (VN799) flew for the first time on May 13, 1949. Deliveries of production Canberras to the Royal Air Force began in January, 1951 and more than 1,200 have since been built by English Electric, Short Brothers and Harland, A. V. Roe, Handley Page and, under licence, by Martin in America and the Department of Defence Production in Australia.

Canberras have been used as flying test-beds for numerous engines including the Bristol Olympus and D.H. Gyron Junior turbojets, and the D.H. Spectre and Napier Double Scorpion liquid-propellant rocket motors. A Canberra powered by two Bristol Olympus engines set up a World's Height Record of 65,890 ft. (20,083 m.) on August 29, 1955. Almost exactly two years later, on August 28, 1957, another Canberra powered by two Rolls-Royce Avon turbojets and a Napier Double Scorpion rocket motor set up a World's Height Record at 70,310 ft. (21,430 m.). The Canberra holds 19 officially-recognised point-to-point speed records.

Canberra B. Mk. 1. This designation refers only to the first four aircraft built. These were two-seat medium bombers, with "solid" nose. The second aircraft had Rolls-Royce Nene engines for experimental flying, the other three being powered by Rolls-Royce Avons.

Canberra B. Mk. 2. Two Rolls-Royce Avon 1 engines, with cartridge-operated turbo-starters. First production version, superseded by the B. Mk. 6. Three-seat medium bomber, with transparent nose cone. Cabin pressurisation from engine compressors in place of two-stage blower on Mk. 1. Crew consists of pilot, navigator/plotter and observer, the two latter being trained navigators. Former navigates by radar on to target, latter acts as bomb-aimer over target. Radio is pilot operated. First B. Mk. 2 (VX 165) flew on April 23, 1950.

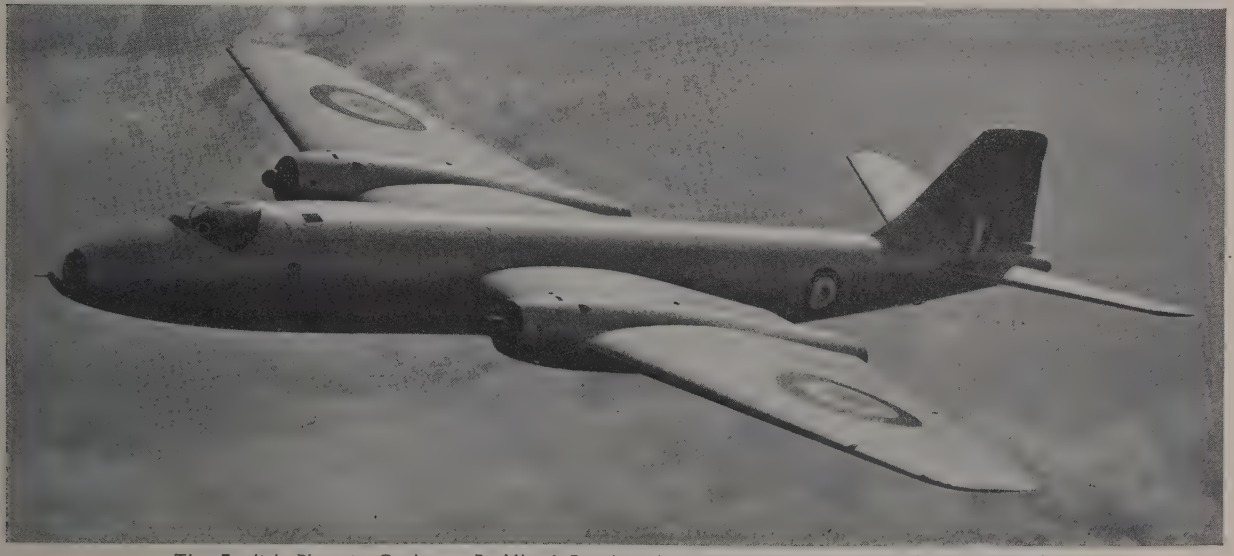
Canberra P.R. Mk. 3. Similar to the B. Mk. 2, but carries equipment for high altitude photographic reconnaissance, and lacks the offset bomb-aiming panel in the transparent nose cap. Length 66 ft. 8 in. (20.3 m.). Superseded by the P.R. Mk. 7. First P.R. Mk. 3 (VX 181) flew on March 19, 1950.

Canberra T. Mk. 4. Trainer version of B. Mk. 2. Crew of three, comprising a pupil and instructor seated side-by-side with dual controls and a navigator behind. First T. Mk. 4 (WM 467) flew on June 6, 1952.

Canberra B. Mk. 5. Target marker version of B. Mk. 2. Solid nose with large optically-flat bomb-aimer's panel beneath nose. Not put in production.

Canberra B. Mk. 6. Similar to Mk. 2 but with more powerful Avon engines and additional fuel capacity. Now superseded by the B.(I) Mk. 8. First B. Mk. 6 (WJ 754) flew on January 26, 1954.

Canberra B. (I.) Mk. 6. Interim night



The English Electric Canberra B. Mk. 6 Bomber (two Rolls-Royce Avon turbojet engines).



The English Electric Canberra B. (I) Mk. 8 Night Interdictor (two Rolls-Royce Avon turbojet engines)

interdictor version of the B. Mk. 6, pending delivery of the B. (I.) Mk. 8. Armament consists of under-wing bombs and a 4 × 20 mm. gun pack under the fuselage.

Canberra P.R. Mk. 7. Similar to Mk. 3 but with more powerful Avon engines and additional fuel capacity. First P.R. Mk. 7 (WH 774) flew on October 28, 1953.

Canberra B. (I.) Mk. 8. Long-range Night Interdictor or High-altitude Bomber and Target Marker, and readily convertible from one rôle to the other. Same power-plant and increased fuel capacity as in Mks. 6 and 7. First B.(I) Mk. 8 (VX 185) flew on July 23, 1954. Details below refer to this version.

Canberra P.R. Mk. 9. High-altitude photographic reconnaissance aircraft to replace the P.R.7. Span increased by 4 ft. (1.22 m.) and chord of centre-section of wing inboard of nacelles extended. Offset fighter canopy as in B. (I.) Mk. 8. Fairey powered controls. Powered by new mark of Rolls-Royce Avon engine of unspecified output. P.R. Mk. 9 aircraft for the R.A.F. are built by Short Brothers and Harland, Ltd. First P.R. Mk. 9 (WH 793) flew on July 8, 1958.

Canberra U. Mk. 10. Pilotless target aircraft. Modification of standard B. Mk. 2 by Short Brothers and Harland, Ltd. Suitable for operation at heights up to 50,000 ft. (15,240 m.).

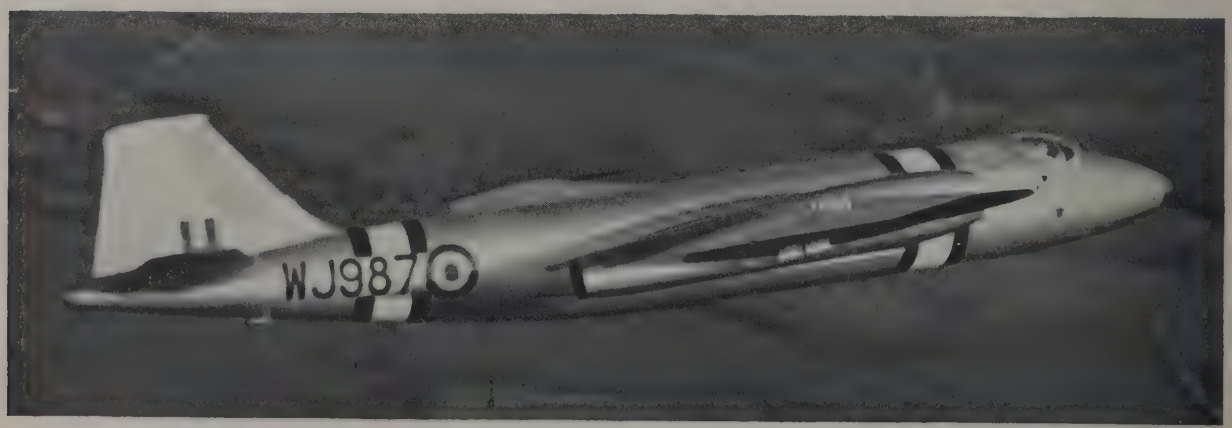
Canberra T. Mk. 11. Modification of Canberra B. Mk. 2 for training pilots and navigators of all-weather fighters in the use of airborne interception radar. The radar equipment is mounted in the fuselage nose and the T. Mk. 11 carries a crew of four, including two pupils. Boulton Paul Aircraft Ltd. were responsible for designing the modification.

Canberra B. Mk. 20. Tactical bomber built in Australia and modified to meet R.A.A.F. operational requirements. Powered by two Australian-built Rolls-Royce Avon engines. First B. Mk. 20 flew for the first time on May 29, 1953.

Canberra T. Mk. 21. This designation given to conversion of five Mk. 20 and two British-built Mk. 2 bombers to trainers by Government Aircraft Factory



The English Electric Canberra P.R. Mk. 9 showing the increased span and centre-section chord.



The English Electric Canberra U. Mk. 10 pilotless Target Aircraft for use as guided weapon development.



The English Electric Canberra T. Mk. 11 Airborne Interception Radar Trainer.

at Fisherman's Bend, Melbourne, Australia.

The following details apply particularly to the B. (I) Mk. 8, but are generally applicable to all versions :—

TYPE.—Long-range Night Interdictor or High-Altitude bomber.

WINGS.—Cantilever mid-wing monoplane. Symmetrical high-speed aerofoil. Dihedral, inner wing (to engine nacelle) 2°, outer wing 4° 21′. Root chord 19 ft. (5.8 m.). Tip chord 7 ft. 8 in. (2.34 m.). All-metal single-spar structure. Irving-Westland pressure-balanced ailerons with spring-tabs in each. Four hydraulically-operated split trailing-edge flaps. Air-brakes consist of drag channels which can be extended from top and bottom wing surfaces. Gross wing area 960 sq. ft. (89 m.²).

FUSELAGE.—All - metal semi - monocoque structure.

TAIL UNIT.—Cantilever monoplane tailplane with dihedral and single fin and rudder. All-metal structure, except for forward portion of fin which is of wood construction, with plywood covering. Variable incidence tailplane hinged at its leading-edge and operated by an English Electric actuator in the rear fuselage. Spring trim-tabs in both elevators. Mass-balanced rudder with spring trim-tab. Area of horizontal tail surfaces 190.8 sq. ft. (17.72 m.²). Area of vertical tail surfaces 66.53 sq. ft. (6.18 m.²). Tailplane span 27 ft. 4.9 in. (8.35 m.). Tailplane dihedral 10 degrees.

LANDING GEAR.—Retractable nose-wheel type. Each main unit, of English Electric design, is an oleo-pneumatic shock-absorber strut carrying a single wheel inboard on a cantilever stub axle. Dowty levered-suspension liquid-spring fully-castoring nose unit with twin wheels. Hydraulic retraction. Dunlop wheels, tyres and plate brakes. Track 15 ft. 9 in. (4.79 m.).

POWER PLANT.—Two Rolls-Royce Avon axial-flow turbojet engines. Oil cooling radiator buried in wings outboard of nacelles. Flame detectors and a fire extinguishing system are fitted. Cartridge-fired turbine starter. Fuel in three main tanks in upper part of fuselage above bomb-bay and in wing tanks. Provision for auxiliary wing-tip tanks, each with capacity of 244 Imp. gallons (1,110 litres).

ACCOMMODATION.—Pilot on Martin-Baker Type I3 ejection seat under fighter-type canopy offset to port side of fuselage. Navigator's seat totally-enclosed in nose. Cabin pressurisation by air supply from engine compressors.

ARMAMENT.—In bomber rôle can carry 6 × 1,000 lb., or 1 × 4,000 lb. and 2 × 1,000 lb., or 8 × 500 lb. bombs internally, plus up to 2,000 lb. of external stores on under-wing pylons. In interdictor role, a pack of four 20 mm. Hispano cannon is installed in rear part of internal weapons bay, leaving room in forward part for 16 × 4.5 in. flares or 3 × 1,000 lb. bombs. Nuclear weapons can be carried.

DIMENSIONS.—
Span 63 ft. 11½ in. (19.5 m.).
Length 65 ft. 6 in. (20 m.).
Height over fin 15 ft. 7 in. (4.75 m.).

WEIGHTS AND PERFORMANCE.—
No data available.

FAIREY

THE FAIREY AVIATION CO., LTD.

HEAD OFFICE : HAYES, MIDDLESEX,
LONDON OFFICE : 24, BRUTON STREET, W.1.

WORKS : HAYES, MIDDLESEX ; HESTON, NEAR HOUNSLOW, MIDDLESEX ; WHITE WALTHAM, NEAR MAIDENHEAD, BERKS. ; STOCKPORT, CHESHIRE ; RINGWAY AERODROME, NEAR MANCHESTER ; AND HAMBLE, HANTS.

Directors : G. W. Hall, F.R.Ae.S. (Chairman and Managing Director); R. Fairey (Vice-Chairman) ; W. Broadbent ; C. H. Chichester Smith, D.S.C., A.F.R.Ae.S. ; R. L. Lickley, B.Sc., D.I.C., M.I.Mech.E., F.R.Ae.S. (Technical Director) ; J. C. Macpherson, A.C.A. ; A. Vines, A.F.R.Ae.S., A.M.I.P.E.

Chief Engineer (Aircraft) : Dr. G. S. Hislop, Ph.D., B.Sc., A.R.T.C., M.I. Mech.E., F.R.Ae.S.

Chief Engineer (Heston) : L. R. E. Appleton, O.B.E., M.A., M.I.Mech.E., F.R.Ae.S.

Chief Designer : D. Wakeford.

The Fairey Aviation Co., Ltd. has specialised on naval types for many years, although not to the exclusion of aircraft suitable for other purposes.

Production during 1958 was concentrated on the Gannet A.E.W. Mk. 3 airborne early warning aircraft for the Royal Navy and on Gannet A.S. Mk. 1 and 4 and T. Mk. 5 aircraft for the Royal Australian Navy and West Germany's Naval Air Arm.

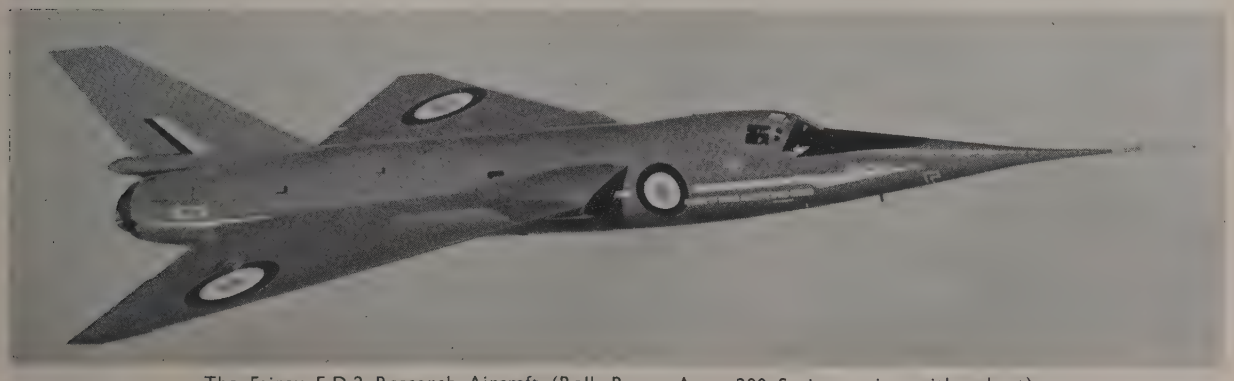
Flight research with the two Fairey Delta 2 research aircraft continued during the year. Development of the Ultra-Light helicopter has also continued on a private venture basis, and one of the prototypes completed successfully a series of open sea trials on board a frigate of the Royal Navy.

The Company has completed the first of two prototypes of its large Rotodyne helicopter, and this aircraft flew for the first time on November 6, 1957. It is now undergoing intensive flight development.

In addition to this work on aircraft of its own design, the Fairey Company is a member of the Aircraft Manufacturing Company consortium which has been formed to produce the D.H. 121 jet transport.

The Company's Weapon Division holds important development and production contracts. Details of its first operational missile, the Fireflash air-to-air guided weapon, were released in 1956 and are to be found in the "Guided Missiles" section of this work.

Other activities of the Fairey Company include the production of power control systems, which are used on Fairey aircraft and also on the Hawker Hunter, Blackburn Beverley, Avro CF-



The Fairey F.D.2 Research Aircraft (Rolls-Royce Avon 200 Series engine with reheat).



The Fairey Gannet A.E.W. Mk. 3 Early Warning Aircraft (Armstrong Siddeley Double Mamba turboprop engine).

100, Vickers-Supermarine Scimitar, English Electric Canberra P.R. Mk. 9, Fiat G.82 and G.91 and other types. The activities of its various subsidiary companies include air survey and air photography, the development and manufacture of plastics, and the design and manufacture of light marine craft.

It was announced in November, 1957 that the Fairey Company has been actively concerned with atomic energy developments for over ten years and is a full member of the officially-recognised group of companies known as Atomic Power Constructions Ltd.

THE FAIREY DELTA 2.

Two prototypes of the Fairey Delta 2 research aircraft have been built, under a Ministry of Supply contract, to investigate the characteristics of flight and control at transonic and supersonic speed in level flight.

The first prototype of the Delta 2 (WG 774) flew on October 7, 1954, and set up a World's Speed Record of 1,132 m.p.h. (1,822 km.h.) on March 10, 1956. The second prototype (WG 777) exceeded the speed of sound during its first flight on February 15, 1956.

TYPE.—Single-seat Supersonic Research aircraft.

WINGS.—Cantilever mid-wing monoplane of delta plan-form. Fairey symmetrical wing section. Thickness/chord ratio 4%. Aspect ratio 2.0. Chord 25 ft. (7.62 m.) at root, 13 ft. 6 in. (4.10 m.) mean. No dihedral. Incidence 1.5°. Sweepback 60°. Light alloy structure with three main and two subsidiary spars. Light alloy ailerons (outboard) and elevators (inboard) on trailing-edges, all powered by Fairey power control units. No flaps. Total area of ailerons 32 sq. ft. (2.97 m.²). Total area of elevators 40 sq. ft. (3.72 m.²). Gross wing area 360 sq. ft. (33.45 m.²).

FUSELAGE.—Light alloy semi-monocoque structure, with removable rear end for engine servicing. Entire nose section, from aft of cockpit, can be pivoted downward through 10° to improve pilot's view during taxying, take-off and landing.

TAIL UNIT.—Fin and rudder only, of light alloy construction. Rudder powered by Fairey power control unit. Areas: fin 30 sq. ft. (2.79 m.²), rudder 9 sq. ft. (0.84 m.²).

LANDING GEAR.—Retractable tricycle type. Fairey oleo shock-absorbers. Hydraulic retraction. Dunlop wheels and high-pressure tyres and Dunlop Maxaret brakes. Cluster of three G.Q. braking parachutes in container at base of rudder. Four hydraulically-operated "petal" air-brakes around jet tailpipe. Wheel track 7 ft. 8 in. (2.34 m.). Wheelbase 14 ft. 4 in. (4.37 m.).

POWER PLANT.—One Rolls-Royce Avon "200-series" turbojet engine with reheat and variable-area nozzle. Fuel in integral wing tanks and collector cell between air intakes.

ACCOMMODATION.—Pilot on Martin-Baker Mk. 3 ejection seat in pressurised air-conditioned cabin. Light alloy jettisonable canopy, containing five transparent panels, hinges to starboard and is manually-operated.

DIMENSIONS.—
Span 26 ft. 10 in. (8.18 m.).
Length 51 ft. 7 in. (15.71 m.).
Height 11 ft. 0 in. (3.35 m.).

THE FAIREY GANNET.

The Gannet is a three-seat anti-submarine aircraft which is in service with the Royal Navy and the Royal Australian Navy. Fifteen of the A.S. Mk. 4 version and one T. Mk. 2 have also been ordered for the German naval forces.

The power-plant of the Gannet is an Armstrong Siddeley Double Mamba which consists basically of two Mamba turboprop engines placed side-by-side, each driving one of two co-axial contra-rotating airscrews. For long-range cruising one or other of the engines and its airscrew can be stopped and feathered, the full power of both engines being used mainly for take-off and for combat.

Five versions of the Gannet have so far been announced. These are :—

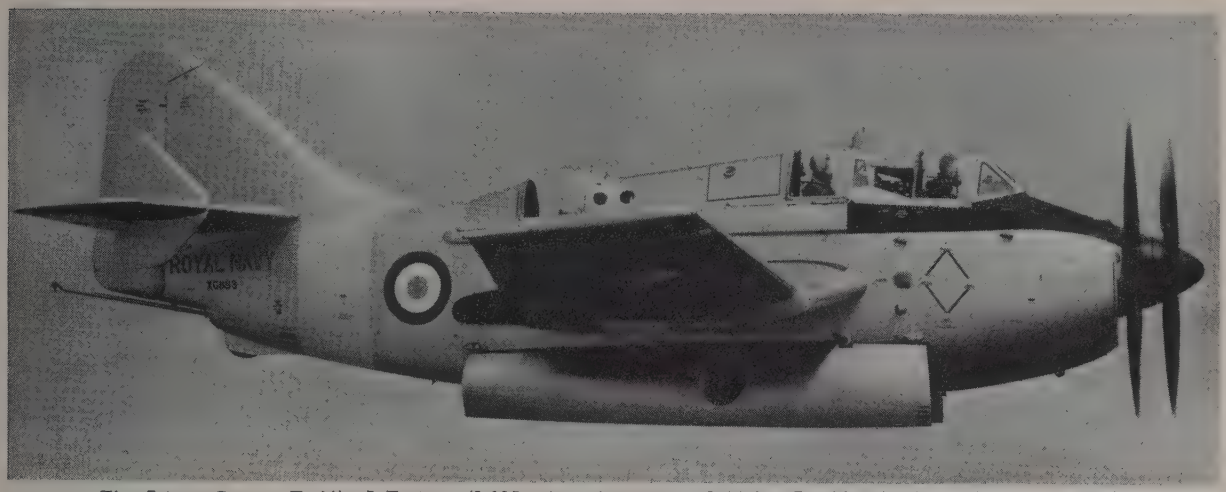
Gannet A.S. Mk. 1. Three-seat anti-submarine aircraft. Pilot in first cockpit, observer/navigator in second cockpit and radio/radar operator in third cockpit. Retractable radome beneath rear fuselage.

Gannet T. Mk. 2. Operational training version of Mk. 1. Duplicated controls in first and second cockpits, with instructor in second. Main function is to provide advanced training in weapon and engine handling, but also to be adaptable for communications. Third cockpit can carry either radio operator or two passengers. No radome.

Gannet A.E.W. Mk. 3. This version of the Gannet will replace the Royal Navy's Skyraider early-warning aircraft. New



The Fairey Gannet A.S. Mk. 4 (3,035 e.h.p. Armstrong Siddeley Double Mamba turboprop engine).



The Fairey Gannet T. Mk. 5 Trainer (3,035 e.h.p. Armstrong Siddeley Double Mamba turboprop engine).

features include deletion of the two rear cockpits, addition of a large underfuselage radar scanner with accommodation inside the fuselage for two radar observers, a square-topped fin and rudder and new engine nozzles exhausting on each side of the fuselage under the wing leading edges. Power plant is a 3,875 e.h.p. Double Mamba 102 (ASMD.8) turboprop. First flew on August 20, 1958.

Gannet A.S. Mk. 4. Similar to Mk. 1 but with more powerful Double Mamba 101 (ASMD.3) turboprop (3,035 e.h.p.). In production. First flew on March 12, 1956.

Gannet T. Mk. 5. Operational trainer. Similar to T. Mk. 2, but with more powerful Double Mamba power-plant as Mk 4. In production. First flew March 1, 1957.

TYPE.—Three-seat Anti-submarine and Training monoplane.

WINGS.—Mid-wing monoplane. All-metal structure. Wings fold mechanically, the inner sections folding up and outer sections folding down simultaneously. Large auxiliary aerofoil type flaps.

FUSELAGE.—All-metal monocoque structure.

TAIL UNIT.—Cantilever monoplane type, with two small auxiliary fins attached to leading edges of tailplane.

LANDING GEAR.—Retractable tricycle type. Fairey oleo-pneumatic shock-absorbers. Hydraulic retraction. Tail sting-type arrester hook. Catapult hooks under forward fuselage.

POWER PLANT.—One Armstrong Siddeley Double Mamba coupled turboprop, driving Rotol co-axial contra-rotating fully-feathering airscrews.

ACCOMMODATION.—Crew of three in tandem in individual cockpits with rearward-sliding canopies. Dual controls fitted in centre cockpit of T. Mk. 2 and T. Mk. 5.

ARMAMENT.—Torpedoes, bombs, depth charges, sono-buoys, etc. in internal bomb-bay. Rockets, sono-buoys, etc. under wings.

DIMENSIONS.—
Span 54 ft. 4 in. (16.56 m.).
Width (wings folded) 19 ft. 6 in. (5.94 m.).
Length 43 ft. (13.11 m.).
Height 13 ft. 8½ in. (4.18 m.).
Height (wings folded) 13 ft. 9 in. (4.19 m.).

WEIGHTS AND PERFORMANCE.—
No data available for publication.

THE FAIREY ULTRA LIGHT HELICOPTER.

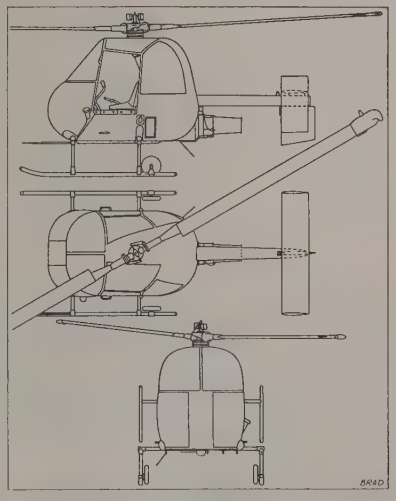
The Fairey Ultra Light Helicopter, which flew for the first time on August 14, 1955, was intended primarily for Army observation and liaison duties.

Ministry of Supply support was withdrawn as an economy measure in 1956, but development is being continued on a private venture basis. Variants of the basic type will be offered with the high performance characteristics of the prototypes, but with much improved payload-range.

The cabin, from which there is an excellent all-round view, seats two side-by-side.

A Blackburn Palouste turbo-compressor supplies compressed air to pressure-jet units at the tips of the two-bladed rotor. Directional control is achieved with a stainless steel rudder located in the engine exhaust.

The Ultra-Light can be transported on a 3-ton truck, and is suitable for all light helicopter duties, including crop spraying, the carriage of stretchers and for transporting quite heavy loads slung externally.



The Fairey Ultra Light Helicopter.

One of the prototypes has demonstrated that the Ultra-Light is suitable for anti-submarine and observation duties at sea, by completing a series of trials during which it operated in rough sea conditions from a small platform on a naval frigate.

The developed version will offer good performance in both standard and tropical conditions, with an extremely high vertical rate of climb. It will be most efficient for operations requiring an endurance of one hour, although maximum endurance will be much greater than this.

TYPE.—Two-seat Light helicopter.

ROTOR SYSTEM.—Two-blade "see-saw" rotor of all-metal construction.

ROTOR DRIVE.—Pressure-jet units of Fairey design built into rotor tips.

FUSELAGE.—All-metal structure, built around central box containing fuel tank.

TAIL UNIT.—Cantilever monoplane type, with two fixed end-plate fins and movable central rudder of all-metal construction. Carried on detachable box-section metal tail-boom.

LANDING GEAR.—Tubular steel skids.

POWER PLANT.—One Blackburn-Turbomeca Palouste 500 air generator which supplies compressed air to rotor tip-mounted pressure-jet units of Fairey design. Crash-proof fuel tank.

ACCOMMODATION.—Enclosed cabin for pilot and passenger side-by-side.

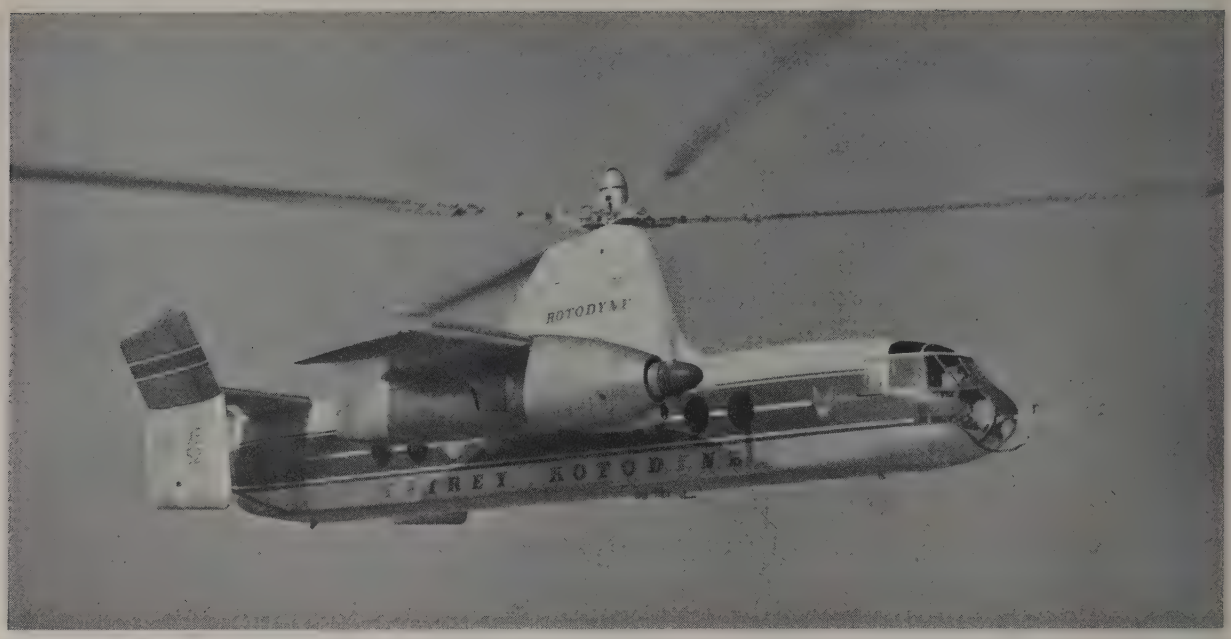
DIMENSIONS.—
Rotor diameter 28 ft. 3½ in. (8.62 m.).
Length of fuselage 14 ft. 1 in. (4.30 m.).
Width of fuselage 6 ft. 6½ in. (2.00 m.).
Height 8 ft. 2 in. (2.49 m.).

WEIGHTS (developed version).—
Max. payload 640 lb. (290 kg.).
Weight loaded 1,800 lb. (817 kg.).

PERFORMANCE.—
Cruising speed 98 m.p.h. (158 km.h.).



The Fairey Ultra Light Helicopter.



The Fairey Rotodyne V.T.O. Transport (two Napier Eland turboprop engines).

Vertical rate of climb at S/L. 950 ft./min. (290 m./min.).
Max. range 184 miles (297 km.).
Max. endurance 2½ hours.

THE FAIREY ROTODYNE.

The Rotodyne, two prototypes of which have been ordered by the Ministry of Supply, is a commercial vehicle capable of carrying 40-48 passengers or approx. 15,000 lb. (6,800 kg.) of freight. The first prototype flew for the first time on November 6, 1957.

One Rotodyne has been ordered by Okanagan Helicopters of Vancouver, B.C., for delivery in 1960-61.

The prototypes each have a loaded weight of 33,000 lb. (14,970 kg.) and are powered by two Napier Eland N.El.3 turboprop engines of 3,000 e.h.p. Production aircraft will be powered by Eland N.El.7 engines of 3,500 e.h.p. Each engine drives an airscrew in constant mesh and also an auxiliary air compressor through a hydraulic clutch. The air compressors supply air through a ducting system to pressure-jet units mounted at the rotor tips. In these units fuel is injected and burned to give high thrust.

Considerable research into noise reduction has led to the development of suppressors which offer a 90 per cent. reduction at a distance of 200 ft. (60 m.) for a loss of only 5 per cent. thrust. The noise level of production aircraft at this distance will be 95 decibels, which is no greater than for large twin-engined helicopters with piston-engines.

The Rotodyne may be flown as a pure helicopter, with tip jets alight and airscrews giving zero thrust, or as an autogyro with engine power going into the airscrews only, the rotor being in autorotation. Tip-jet-powered flight is used for take-off and landing; intermediate cruise flight is carried out as an autogyro. A feature of the design is that adequate single-engine performance is provided following an engine failure at any speed.

Transition from vertical flight to horizontal flight, with the rotor autorotating, was carried out for the first time on April 10, 1958, and has since been a routine feature of the flight test programme.

The Rotodyne has an unrestricted cabin space of 3,300 cub. ft. (93.45 m.³) permitting great flexibility of employment. Rear clam-shell doors give unobstructed entry for large loads including motor vehicles and a forward door permits simultaneous entry and exit of passengers for quick turn-around time.

The data below refers to the production version, but is generally applicable to the prototypes.

TYPE.—Large Transport Helicopter.

ROTOR SYSTEM.—Single four-blade main rotor of all-metal (mainly stainless steel) two-spar construction. Blade chord 27 in. (0.68 m.). Swashplate-type of control mechanism. Area of each main rotor blade 79 sq. ft. (7.34 m.²). Total disc area 6,350 sq. ft. (590 m.²). No antitorque rotor.

ROTOR DRIVE.—Tip-mounted pressure-jet units of Fairey design.

FIXED WINGS.—Cantilever high-wing monoplane. Conventional all-metal two-spar structure. Wing area 475 sq. ft. (44.12 m.²).

FUSELAGE.—All-metal monocoque structure.

TAIL UNIT.—Braced monoplane type with twin fins and rudders. All-metal structure.

LANDING GEAR.—Retractable tricycle type. Fairey oleo-pneumatic shock absorbers. Dunlop or Goodyear wheels. Wheel track 24 ft. 6 in. (7.47 m.). Wheelbase 23 ft. 9 in. (7.24 m.).

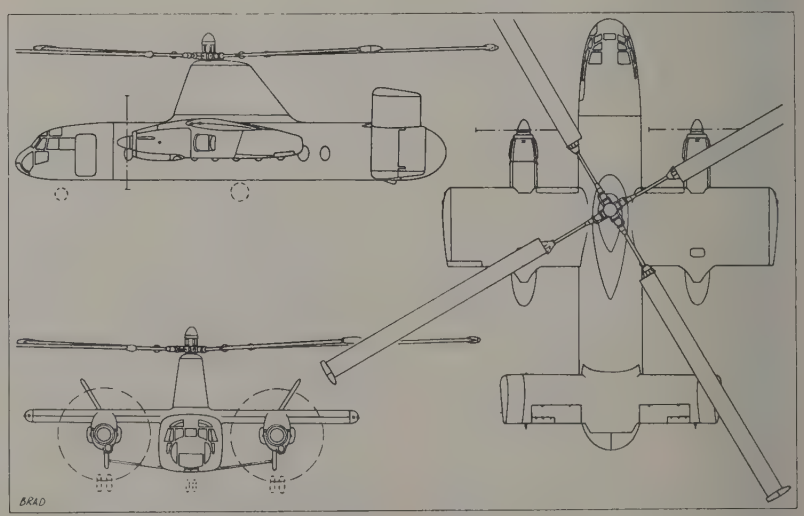
POWER PLANT.—Two 3,500 e.h.p. Napier Eland N.El.7 turboprop engines mounted under fixed wings in conventional manner and driving Rotol four-blade airscrews, diameter 13 ft. (3.96 m.). Fuel in bag-type tanks in wings, with total capacity of 7,500 lb. (3,400 kg.).

ACCOMMODATION.—Pilot and co-pilot side-by-side in nose, with dual controls. Cabin with 3,300 cub. ft. (93.45 m.³) unrestricted space for 40-48 passengers or 15,000 lb. (6,800 kg.) freight. Cabin is 46 ft. long, 8 ft. wide and 6 ft. high (14.0 m. × 2.44 m. × 1.83 m.). Floor height above ground 41 in. (1.04 m.).

DIMENSIONS.—
Main rotor diameter 90 ft. (27.4 m.).
Length of fuselage 58 ft. 8 in. (17.88 m.).
Span of fixed wings 46 ft. 6 in. (14.17 m.).
Height to top of rotor pylon 22 ft. 2 in. (6.75 m.).

WEIGHT (Eland N.El.3 engines).—
Weight loaded 33,000 lb. (14,970 kg.).

PERFORMANCE (Estimated—N.El.7 engines).—
Cruising speed 184 m.p.h. (297 km.h.).
Vertical rate of climb at S/L. 1,800 ft./min. (550 m./min.).
Stage length with 48 passengers and full reserves 230 miles (370 km.).



The Fairey Rotodyne.

FOLLAND

FOLLAND AIRCRAFT LTD.

HEAD OFFICE AND WORKS: HAMBLE, SOUTHAMPTON, HAMPSHIRE.

Chairman: C. L. Hill.

Directors: W. E. W. Petter, C.B.E., B.A., F.R.Ae.S. (Managing, and Chief Engineer), E. N. Egan, F.C.W.A. (Assistant Managing), E. C. Lysaght, Sir Raymond Quilter, Bt., C. E. Blunt.

This company was originally formed as British Marine Aircraft, Ltd., in August, 1935. This became a public company in February, 1936 and the change of name was made in December, 1937. The main factory is at Hamble and there are branch works at Eastleigh Airport, Chilbolton and elsewhere in the Southampton district.

Since the war, the company has been largely occupied with sub-contract work, which has included the production of wings for the de Havilland Vampire, Venom and Sea Venom and, more recently, tailplanes for the Hawker Hunter fighter, engine nacelles for the Bristol Britannia airliner and centre-sections for the de Havilland Sea Vixen. Another activity has been the development of a lightweight ejection seat from a basic design by the Swedish SAAB company.

In 1951, Folland started work on the design of a private-venture light fighter, the Gnat, under the direction of Mr. W. E. W. Petter, the company's Managing Director.

At first the company had the encouragement of the Air Ministry, but this lapsed when the development of the original engine around which the Gnat had been designed was abandoned. The company however, decided to alter the design sufficiently to take the lower-powered Armstrong Siddeley "long life" Viper engine in order to gain flight experience. To avoid confusion the Viper-powered prototype was named the Midge.

The Midge flew for the first time on August 11, 1954, and underwent extensive flight testing, during which it was dived at supersonic speed despite the low power (1,640 lb.=745 kg. s.t.) of its engine.

Meanwhile, in November, 1953, the Bristol Aeroplane Company had announced its intention to design and build the Orpheus engine and, following this, work on the Gnat was resumed.

The first Gnat prototype made its maiden flight on July 18, 1955, and the second (the first of a batch of five for the Ministry of Supply) made its first flight on May 26, 1956.

So far, orders have been received for Gnats and Gnat Trainers from the Ministry of Supply and the Indian, Finnish and Yugoslav Governments. Deliveries to India and Finland began in 1958. The aircraft will also be built under licence in India by Hindustan Aircraft Ltd. and Valmet Oy have a licence to build it in Finland.

THE FOLLAND Fo. 141 GNAT.

The following versions of the Gnat have been announced:—

Gnat Mk. 1. Standard single-seat fighter version. Bristol Orpheus 701 (BOr.2) turbojet (4,520 lb.=2,050 kg. s.t.). Five for Ministry of Supply, 25 complete aircraft and 15 sets of components for India, 12 for Finland and two for Yugoslavia.

Gnat 2. Prototype under development as private venture. Basically similar to Gnat Mk. 1, but with 6% t/c. wing and Orpheus turbojet with reheat, giving maximum speed of Mach 1.3, improved rate of climb and as good or better range. Developed versions will have A.I. radar and air-to-air rocket or missile armament. Prototype scheduled to fly in 1959.

The Gnat Mk. 1 lightweight fighter is approximately one-third the weight and half the size of a standard jet fighter. It is built without the use of large and costly machine tools and therefore shows also a substantial saving in cost.

Despite its small size, the Gnat Mk. 1 has a high subsonic speed in level flight, an exceptionally good rate of climb and small turning radius.

The following specification applies specifically to the Gnat Mk. 1.

TYPE.—Single-seat lightweight Fighter or Fighter-Bomber.

WINGS.—Shoulder-wing cantilever swept-wing monoplane. RAE. 102 (modified) wing section. Angle of sweepback 40°. Chord (mean) 6 ft. 2 in. (1.87 m.). Thickness/chord ratio 8%. Aspect ratio 3.575. Anhedral 5°. One-piece wing of two-spar thick-skin light alloy construction fits in recess in top of fuselage and secured by bolts at four main points. Power-operated large-area inboard ailerons. Ailerons droop to serve as flaps. Gross wing area 136.6 sq. ft. (12.69 m.²).

FUSELAGE.—Light alloy semi-monocoque structure.

TAIL UNIT.—Cantilever monoplane type. Hydraulically-operated (by Hobson actuator) tailplane. Vertical area 14 sq. ft. (1.30 m.²). Horizontal area 18 sq. ft. (1.66 m.²). Span of tail 9 ft. (2.74 m.).

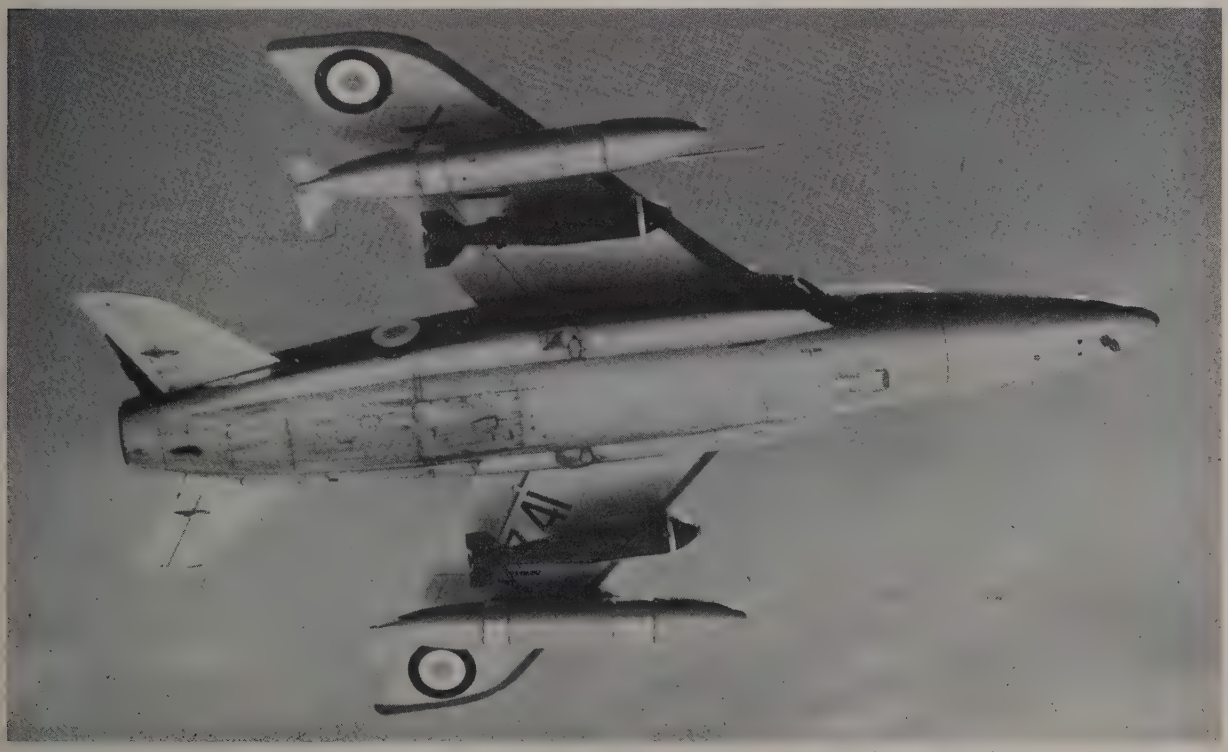
LANDING GEAR.—Retractable nose-wheel type, all wheels retracting into fuselage. Hydraulic actuation. Messier oleo-pneumatic shock-absorber struts. Wheel well fairings attached to individual landing-gear units serve as air-brakes when landing-gear is partly lowered, the relative movements of the air brakes being so adjusted that no change of trim occurs at any speed. A stop on landing-gear air brake selector prevents gear from being fully lowered when braking is desired. Toe-operated Dunlop disc wheel brakes. Main wheel tyres 20×5.25, nose-wheel tyres (twin) 17×3.25. Braking parachute in container at base of fin. Wheelbase 7 ft. 9 in. (2.36 m.). Track 5 ft. 1 in. (1.55 m.).

POWER PLANT.—One Bristol Orpheus 701 (BOr.2) axial-flow turbojet engine (4,520 lb. = 2,050 kg. s.t.) Air intakes in sides of fuselage. All fuel in seven (plus two optional) fuselage tanks with common collector tank and one booster pump. Total internal fuel capacity 200 Imp. gallons (909 litres), including two optional tanks in rear fuselage with total capacity of 25 Imp. gallons (114 litres). To provide extra range two under-wing jettisonable tanks, each with capacity of 66 Imp. gallons (300 litres), can be fitted. Compressed-air starting, air bottles being filled by two-stage petrol engine-driven compressor on ground rig.

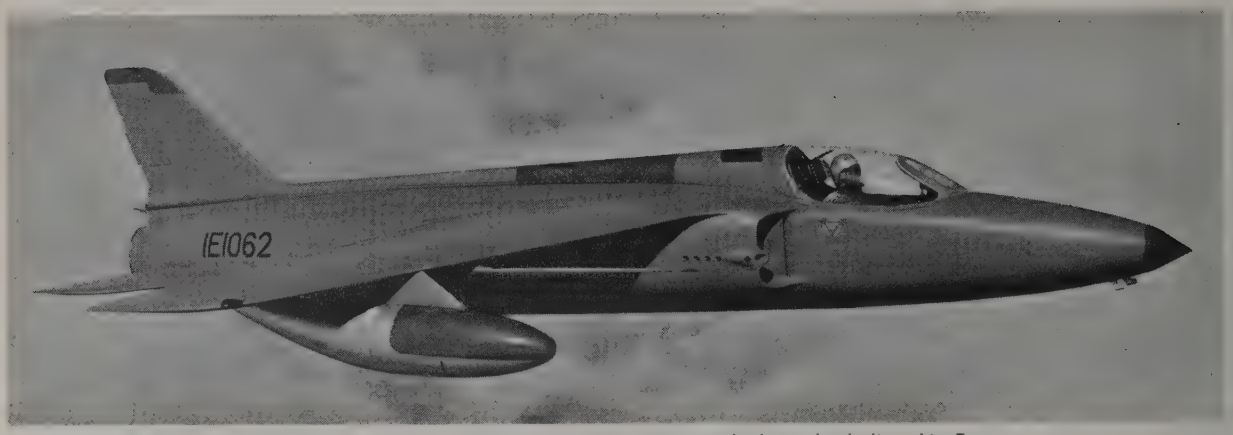
ACCOMMODATION.—Single-seat pressurised cockpit with jettisonable canopy. Folland-Saab lightweight automatic ejector seat. Standard cockpit instrumentation.

ARMAMENT.—Two 30 mm. Aden cannon in the air intake fairings, one on each side of fuselage, with 115 rounds per gun. Provision for underwing mounting of two 500-lb. (227 kg.) bombs or twelve 3-inch (7.6 cm.) rocket projectiles, etc.

EQUIPMENT.—VHF radio and standby set and navigation aids, gyro gun-sight and radar ranging, supplementary oxygen supply, braking parachute, etc.



The Folland Gnat Mk. 1 Lightweight Fighter (Bristol Orpheus turbojet engine).



The Folland Gnat Mk. I Lightweight Fighter as supplied to the Indian Air Force.

DIMENSIONS.—
Span 22 ft. 2 in. (6.75 m.).
Length 29 ft. 9 in. (9.06 m.).
Height 8 ft. 10 in. (2.69 m.).

WEIGHTS.—
Interceptor version: loaded weight 6,575 lbs. (2,980 kg.).
Tactical version: max. loaded weight with external tanks and armament 8,765 lb. (3,970 kg.).

PERFORMANCE.—
Max. speed Mach 0.98.
Climb to 45,000 ft. (13,700 m.) 5 min.
Ceiling over 50,000 ft. (15,000 m.).
Take-off distance to clear 50 ft. (15.25 m.) (interceptor) 2,190 ft. (668 m.).
Take-off distance to clear 50 ft. (15.25 m.) (tactical) 3,780 ft. (1,150 m.).
Landing distance from 50 ft. (15.25 m.) 3,300 ft. (1,020 m.).
Radius of action 500 miles (925 km.).
Normal endurance 1 hr. 10 min.
Endurance with under-wing tanks 2 hr. 15 min.

THE FOLLAND Fo. 144 GNAT TRAINER.

Although basically-similar to the Gnat Mk. 1 fighter, the tandem two-seat Gnat Trainer has a new wing of increased area and decreased thickness/chord ratio, together with larger tail surfaces. It has improved low-speed handling characteristics, while retaining the performance and manoeuvrability of the fighter, and is intended for advanced and transonic flying training.

The rear pilot occupies the space which is taken up by equipment and fuel tanks in the Gnat Mk. 1. To compensate for this loss of fuel capacity, extra tanks are installed in the space occupied by guns and ammunition on the fighter and in the wing inner and centre sections.

An initial production series of 14 Gnat Trainers has been ordered for the Royal Air Force, and the type is expected to replace the Vampire T.11 as the standard advanced trainer of R.A.F. Flying Training Command in due course.

TYPE.—Two-seat advanced Trainer.

WINGS.—Cantilever shoulder-wing monoplane. RAE.102 (modified) wing section. Aspect ratio 3.29. Chord 9 ft. 9 in. (2.97 m.) at C/L, 4 ft. 10½ in. (1.48 m.) at tip. Anhedral 5°. No incidence. Sweepback 40° at 25% chord. T/C ratio 7%. Multi-spar stressed-skin light alloy structure. Outboard ailerons, powered by Lockheed hydraulic jacks, of light alloy construction. Inboard split flaps of light alloy construction. Total area of ailerons 12.7 sq. ft. (1.18 m.²). Total area of flaps 13.5 sq. ft. (1.25 m.²). Gross wing area 175 sq. ft. (16.26 m.²).

FUSELAGE.—Of similar construction to that of Gnat Mk. 1.

TAIL UNIT.—Cantilever monoplane type. Stressed-skin light alloy structure. One-piece tailplane operated by Hobson hydraulic actuator. Rudder manually controlled. Lateral autostabiliser fitted. Areas: fin 16.5 sq. ft. (1.53 m.²), rudder 3.75 sq. ft. (0.35 m.²), tailplane 23.5 sq. ft. (2.18 m.²), elevators 5.56 sq. ft. (0.51 m.²). Tailplane span 10 ft. 10 in. (3.31 m.).

LANDING GEAR.—Basically-similar to that of Gnat Mk. 1 with similar air-brake operation. Wheel track 5 ft. 1 in. (1.55 m.). Wheelbase 8 ft. 6 in. (2.59 m.).

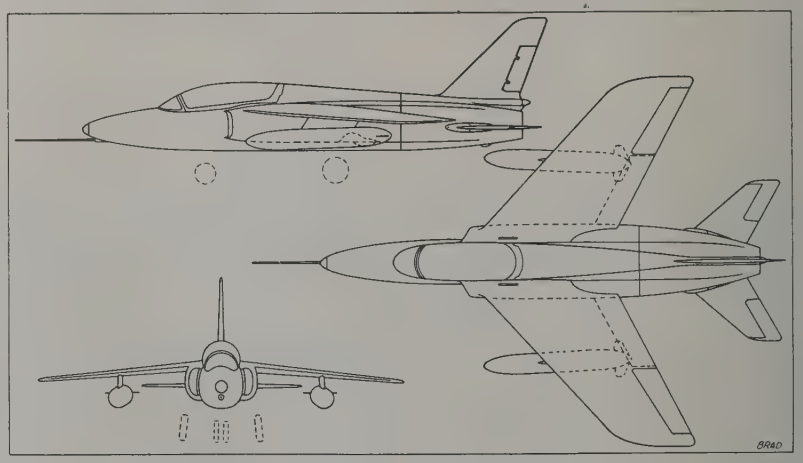
POWER PLANT.—One Bristol Orpheus BOr.4 turbojet engine (4,230 lb.=1,919 kg. s.t.). Fuel in seven bag tanks in fuselage, plus integral tanks in wing centre and inboard portions. Total fuel capacity 264 Imp. gallons (1,200 litres). Provision for two 66 Imp. gallon (300 litre) Folland jettisonable underwing tanks.

ACCOMMODATION.—Crew of two in tandem on Folland fully-automatic lightweight ejection seats under large one-piece jettisonable canopy. Equipment includes V.H.F and V.H.F. standby, I.L.S., TACAN, "Zero Reader" flight computer, M.R.G. and gyro-magnetic compass system.

DIMENSIONS.—
Span 24 ft. (7.32 m.).
Length 30 ft. 9 in. (9.37 m.).
Height 9 ft. 7½ in. (2.93 m.).

WEIGHTS.—
Basic weight 5,070 lb. (2,300 kg.).
Normal loaded weight 7,435 lb. (3,365 kg.).
Max. loaded weight with external tanks 8,560 lb. (3,880 kg.).

PERFORMANCE (estimated).—
Max. speed over Mach 0.95.
Take-off distance 1,560 ft. (475 m.).
Landing distance with braking parachute 1,410 ft. (430 m.).
Endurance with external tanks 2 hr. 15 min.



The Folland Gnat two-seat Trainer.

GLOSTER

GLOSTER AIRCRAFT CO. LTD.

HEAD OFFICE, WORKS AND AERODROME: GLOUCESTER.

Directors: Sir Frank Spriggs, K.B.E., Hon. F.R.Ae.S. (Chairman); Sir Thomas Sopwith, C.B.E., F.R.Ae.S.; H. Burroughes, F.R.Ae.S.; R. V. Atkinson (Works Director); R. W. Walker, F.R.Ae.S. (Director and Chief Designer) and E. W. Shambrook, F.C.I.S. (Secretary).

The Gloster Aircraft Co., Ltd., which forms part of the Hawker Siddeley Group, was formed in 1915 and since then has specialised mainly in the production of high-performance military aircraft.

To the Gloster company belongs the distinction of being the first aircraft manufacturer in either Great Britain or the United States to design, build and fly an aircraft propelled by a gas-turbine jet engine. From the experience gained in the design, construction and flight testing of the two E.28/39 prototypes, the first of which flew on May 15, 1941, the Gloster company designed and put into production the Meteor single-seat twin-jet fighter.

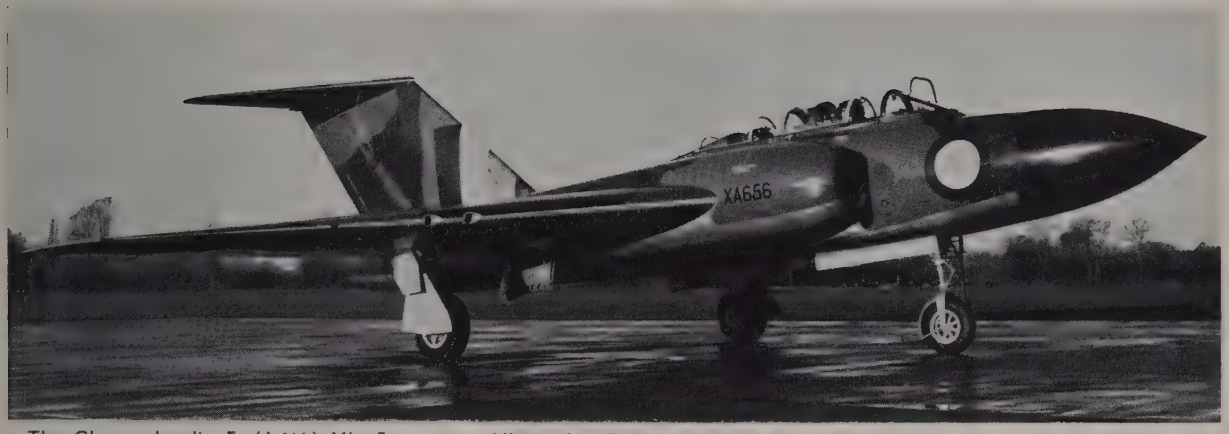
Many versions of the Meteor entered service with the R.A.F. and overseas air forces. All have been fully described in earlier editions of "All the World's Aircraft."

In June, 1952, the Javelin two-seat twin-engined delta-wing all-weather fighter was ordered into production for the Royal Air Force and it is now standard equipment in Fighter Command.

Over and above its normal production commitments, the Company is engaged in a very extensive development and research programme. Its Technical Developments Division, formed in 1956, was established to make available to general industry various examples of aeronautical technology.

THE GLOSTER G.A.5 JAVELIN.

The Javelin was the first twin-engined delta-wing aircraft and the first in Britain to be designed for a specific operational rôle—that of an All-weather Fighter. Five prototypes were built, the first flying for the first time on November 26, 1951. The first production Javelin F. (AW) Mk. 1 flew on July 22, 1954, and this type entered service with R.A.F. Fighter Command in 1956.



The Gloster Javelin F. (A.W.) Mk. 5 two-seat All-weather Fighter (two Armstrong Siddeley Sapphire turbojet engines).

The following versions of the Javelin have been announced :—

Javelin F. (AW) Mk. 1. Initial production version, with Sapphire ASSa.6 engines (8,300 lb.=3,770 kg. s.t.).

Javelin F. (AW) Mk. 2. Similar to Mk. 1, but with equipment changes. Prototype flew October 31, 1955, and first production model April 25, 1956.

Javelin T. Mk. 3. Dual-control trainer. Prototype, built by Air Service Training Ltd., flew August 20, 1956. Fuselage lengthened to 61 ft. 0 in. (18.59 m.). No nose radar. "All flying" tail. Martin-Baker ejection seats.

Javelin F. (AW) Mk. 4. Similar to Mk. 1, but with "all flying" tail. Prototype flew September 19, 1955, and first production model February 27, 1956.

Javelin F. (AW) Mk. 5. New wing with increased internal fuel capacity. Prototype flew July 26, 1956, and first production model August 24, 1956.

Javelin F. (AW) Mk. 6. Similar to Mk. 5, but with equipment changes. Prototype flew December 14, 1956, and first production model January 15, 1957.

Javelin F. (AW) Mk. 7. Similar to Mk. 4, but with Sapphire ASSa.7 engines (each 11,000 lb.=4,990 kg. s.t.). Will be fitted eventually with reheat. Prototype flew April 27, 1956 and first production model November 9, 1956.

Javelin F. (AW) Mk. 8. Similar to Mk. 7 but with equipment changes. First flew on May 9, 1958. Shown at 1958 S.B.A.C. Display with two Sapphire ASSa.7 engines and reheat (each 12,300 lb.=5,580 kg. s.t.), and armament of four Firestreak missiles and two 30 mm. cannon.

The only details of the Javelin which were available for publication at the time of going to press follow.

TYPE.—Two-seat All-weather Fighter.

WINGS.—Mid-wing monoplane of Delta configuration. Wing section RAE. 101. Sweepback at 25% of chord 39.5° on inner wing, 33.8° on outer wing. All-metal stressed-skin structure. Power-boosted all-metal ailerons. Hydraulically-operated all-metal slotted flaps and air-brakes.

FUSELAGE.—All-metal stressed-skin structure.

TAIL UNIT.—All surfaces swept-back. Sweepback at 25% of chord, 47.6° on fin, 42.8° on tailplane. Variable-incidence delta tailplane at top of fin on Mk. 1. "All flying" tail on later Mks. All-metal stressed-skin structure. Tailplane span 17 ft. (5.18 m.).

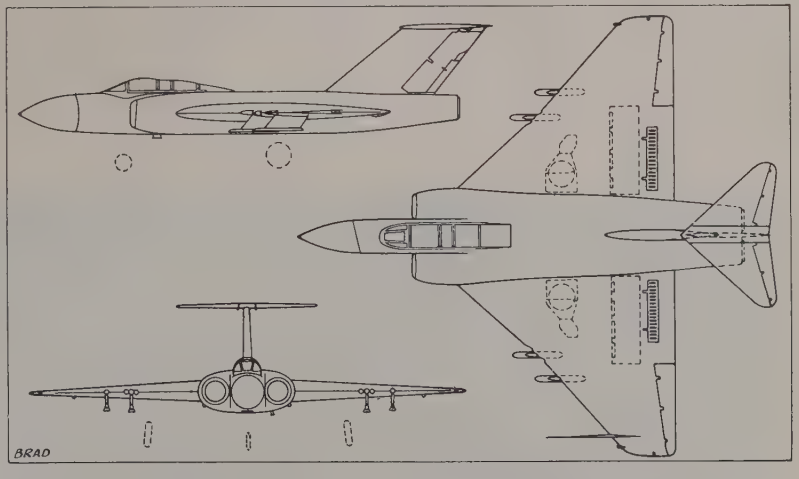
LANDING GEAR.—Retractable nose-wheel type. Hydraulic actuation. Dowty liquid-spring shock-absorbers. Dunlop wheels. Lockheed hydraulic disc brakes with Maxaret control. Track: 23 ft. 4 in. (7.11 m.).

POWER PLANT.—Two Armstrong Siddeley Sapphire turbojet engines in nacelles on sides of fuselage. Mks. 7 and 8 will be fitted eventually with reheat. Two 250 Imp. gallon (1,136 litres) external fuel tanks can be carried under the fuselage of all Mks.

ACCOMMODATION.—Crew of two, pilot and radar-operator, in tandem in pressurised cockpit. Martin-Baker ejection seats. Full air-conditioning.

ARMAMENT.—Mks. 1-6 have four 30 mm. Aden guns mounted two in each wing. Mks. 7 and 8 have one gun in each wing and can carry two Firestreak missiles, or one Firestreak and a pod containing 37 × 2 in. unguided rockets under each wing. Alternative underwing loads include four 1,000 lb. bombs or four 100 Imp. gallon (455 litre) fuel tanks.

DIMENSIONS.—
Span 52 ft. (15.86 m.).
Length 56 ft. 4 in. (17.18 m.).
Height (over tail, static position) 16 ft. (4.88 m.).



The Gloster Javelin two-seat All-weather Fighter.



The Gloster Javelin F. (A.W.) Mk. 8 (two Armstrong Siddeley Sapphire engines with reheat).

HANDLEY PAGE

HANDLEY PAGE, LTD.

HEAD OFFICE AND WORKS: CRICKLEWOOD, LONDON, N.W.2.

AERODROME: COLNEY STREET, RADLETT, HERTFORDSHIRE.

HANDLEY PAGE (READING) LTD.

REGISTERED OFFICE: CRICKLEWOOD, LONDON, N.W.2.

WORKS: WOODLEY, NEAR READING, BERKS.

Directors: Sir Frederick Handley Page, C.B.E., Hon. F.R.Ae.S. (Chairman and Managing Director); G. C. D. Russell, A.F.R.Ae.S. (Assistant Managing Director); R. S. Stafford, C.B.E., F.R.Ae.S. (Technical Director); Group Capt. R. C. M. Collard, D.S.O., D.F.C. (Sales Director); A. A. Lough, F.C.A.; E. Manley Walker.

Chief Designer, Handley Page, Ltd.: C. F. Joy, F.R.Ae.S.

Technical Director, Handley Page (Reading) Ltd.: G. R. Volkert, C.B.E., F.R.Ae.S.

Chief Designer, Handley Page (Reading) Ltd.: J. Allan, Dip.Ae. (Hull), A.F.R.Ae.S.

Secretary: J. H. S. Green, A.C.A.

Handley Page, Ltd., has been associated with flying in all its aspects since June 17, 1909. It thus possesses the proud distinction of being the first limited company incorporated in Great Britain for the purpose of manufacturing aircraft.

The latest product of Handley Page, Ltd. to see service with the Royal Air Force is the "crescent-wing" Victor long-range strategic bomber.

Handley Page has prepared designs for a military transport and a civil airliner based on the Victor bomber and, as a long-term project, is investigating the design of a supersonic civil transport in conjunction with several other manufacturers.

Since 1953, the company has been engaged on laminar flow research with a two-seat Vampire. A special "glove wing" test section, mounted on the upper surface of the aircraft's port wing, incorporates 39 spanwise suction-surface strips, through which a small amount of the boundary layer air is drawn into ducts beneath the wing surface. Suction is provided by a turbine-driven blower, powered by air tapped from the turbojet engine compressor. Flight tests have shown that skin-friction drag can be reduced by as much as 82% using this technique, and Handley Page has completed design studies for various laminarised transports with ranges up to 9,000 miles (14,400 km.).

Handley Page (Reading), Ltd. was formed in June, 1948, when Handley Page, Ltd. took over Miles Aircraft, Ltd. At the same time it acquired the production rights of the Miles Marathon feeder-line transport, which was put into production as the Handley Page Marathon.

The latest Handley Page (Reading) design is the Dart Herald, a medium-range civil transport powered by two Rolls-Royce Dart turboprops.

THE HANDLEY PAGE H.P.113.

The H.P.113 is a 12-seat jet transport designed both as a research aircraft to demonstrate the advantages of the Handley Page laminar-flow boundary layer control system and as a potential long-range executive aircraft. Construction of a prototype was scheduled to begin late in 1958, for flight in 1960-61.

Of conventional low-wing monoplane layout, with 35° swept wings and a T-type tail unit, the H.P.113 will be powered by two Bristol Orpheus turbojets, mounted in its rear fuselage and each driving a suction pump for the boundary layer control system in the wings. Total fuel capacity will be 2,290 Imp. gallons (10,410 litres).

DIMENSIONS.—
- Span 71 ft. 3 in. (21.72 m.).
- Length 71 ft. 6 in. (21.79 m.).
- Height 17 ft. (5.18 m.).
- Wing area 775 sq. ft. (72 m.²).

WEIGHT.—
- Max. payload 2,520 lb. (1,143 kg.).
- Weight loaded 36,500 lb. (16,556 kg.).

PERFORMANCE (estimated).—
- Cruising speed 528 m.p.h. (850 km.h.).
- Time to 50,000 ft. (9,150 m.) 14 min.
- Take-off distance to 50 ft. (15.25 m.) 3,260 ft. (995 m.).
- Landing distance from 50 ft. (15.25 m.) 2,480 ft. (755 m.).
- Max. stage length with 1,000 lb. (454 lb.) payload 4,330 miles (6,970 km.).

THE HANDLEY PAGE H.P.80 VICTOR.

The Victor four-jet bomber employs the so-called "crescent wing" in which the angle of sweep of each wing is progressively decreased from root to tip, with the outer sections only slightly swept.

This configuration was evolved to meet the demands of a specification which called not only for operation at high sub-sonic speeds at altitude over very long ranges, but also good control over the whole speed range, particularly at the approach and landing.

Two versions of the Victor have been announced:—

Victor B. Mk. 1. Initial production version with four Armstrong Siddeley Sapphire turbojets. First of two prototypes flew December 24, 1952. Production aircraft have slightly longer nose than prototypes, single-piece wing leading-edge flaps and no dorsal fin. First deliveries to the Royal Air Force made in November, 1957.

Victor B. Mk. 2. Developed version with four Rolls-Royce Conway R.Co.11 turbojets. To be armed with the Avro powered stand-off bomb.

In 1955 the Under Secretary of State for Air revealed that the Victor has flown to within a small fraction of the speed of sound at an altitude of over 50,000 ft. (15,250 m.), and in 1957 a production Victor exceeded the speed of sound in a dive.

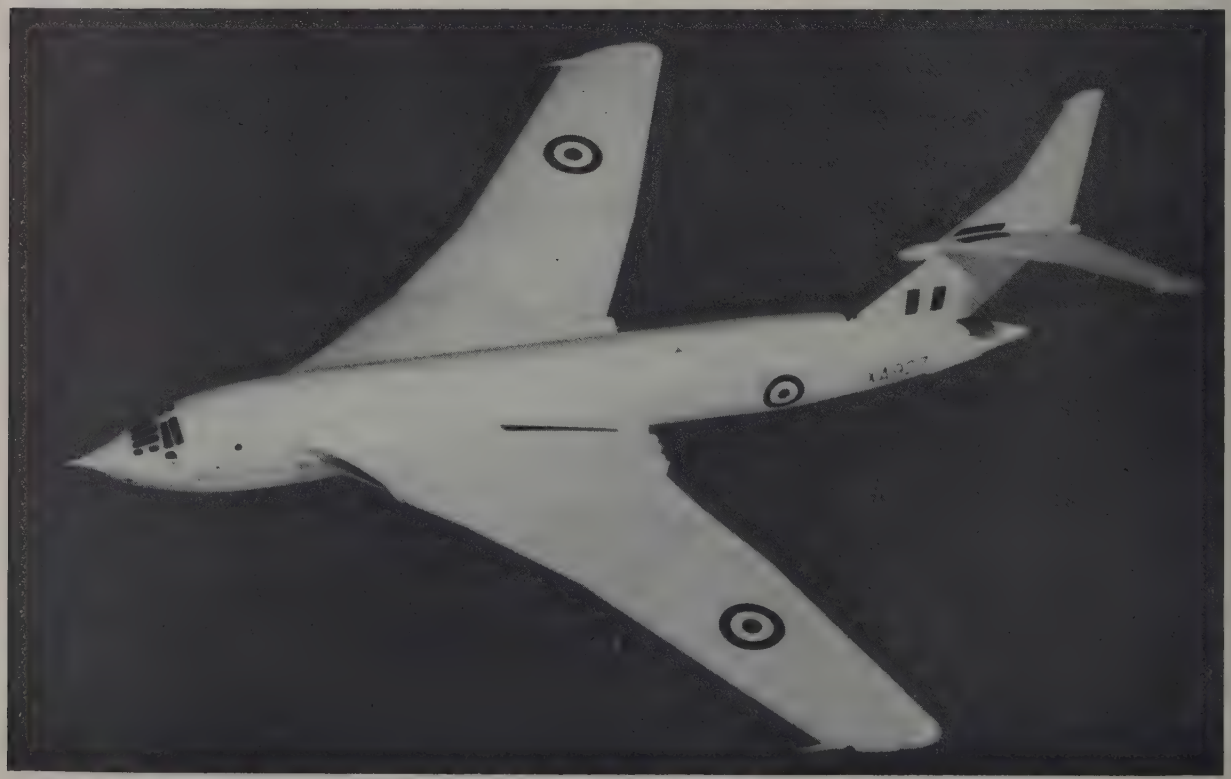
TYPE.—Four-jet medium bomber.

WINGS.—Mid-wing cantilever monoplane of "crescent" planform. All-metal structure. Inner portion of each wing is a three-spar structure. Outboard of the landing gear, the wing is a four-spar structure. Only eight major ribs in each wing. Extensive use of sandwich skin panels. All-metal powered ailerons, with trim-tabs. Fowler type flaps on inboard trailing-edges. Two piece leading-edge flap on each outer wing, with integral hot-air anti-icing.

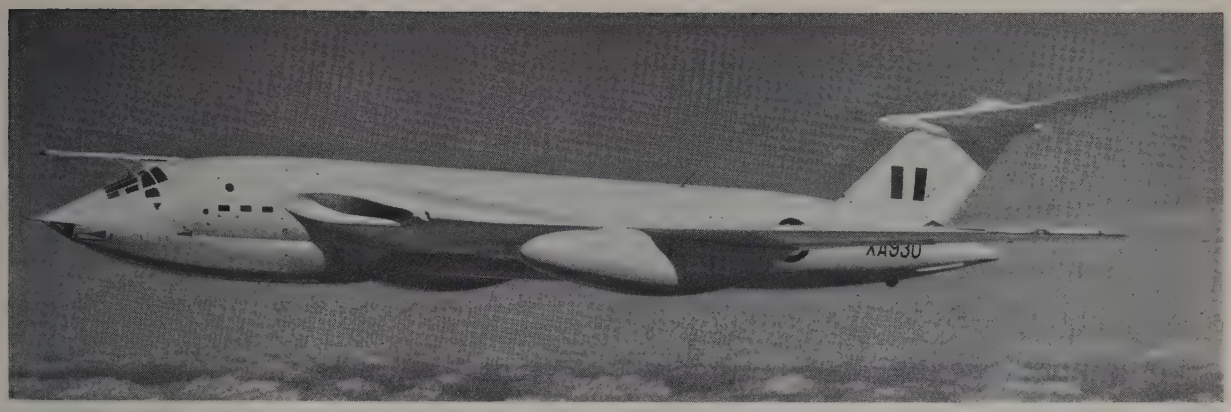
FUSELAGE.—All-metal semi-monocoque structure. Large dielectric panel under nose. Airbrake on each side of tail-cone.

TAIL UNIT.—Cantilever monoplane type, with tailplane at tip of fin. All-metal structure. Powered elevators. Hot-air anti-icing of fin and tailplane leading-edges.

LANDING GEAR.—Retractable tricycle type. Each main unit has eight-wheel bogie. Twin-wheel nose unit. Small tail bumper



The Handley Page Victor B. Mk. 1 (four Armstrong Siddeley Sapphire turbojet engines).



The Handley Page Victor B. Mk. 1 with Flight-Refuelling probe and underwing auxiliary tanks.

wheel. Large ribbon-type braking parachute stowed in fuselage tail-cone.

POWER PLANT.—Mk. 1 has four 11,000 lb. (4,990 kg.) s.t. Armstrong Siddeley Sapphire ASSa.7 turbojets. Mk. 2 has four 17,250 lb. (7,825 kg.) s.t. Rolls-Royce Conway R. Co. 11 turbojets. Bag-type fuel tanks in wings. Provision for two very large underwing tanks. Flight refuelling probe projects above windscreen.

ACCOMMODATION.—Crew of five in pressurised nose compartment. Entrance door on port side of nose.

DIMENSIONS.—
Span 110 ft. (33.5 m.).
Length 114 ft. 11 in. (35.0 m.).
Height 28 ft. 1½ in. (8.60 m.).

THE HANDLEY PAGE DART HERALD.

The Herald, which originates from the Handley Page (Reading) design department, is a pressurised high-wing civil transport which has been designed to operate from primitive airfields under a wide range of climatic conditions. In its latest form it is powered by two Rolls-Royce Dart Mk. 527 turboprop engines.

The prototype Dart Herald, a modification of one of the two prototypes of the original piston-engined Herald, made its first flight on March 11, 1958.

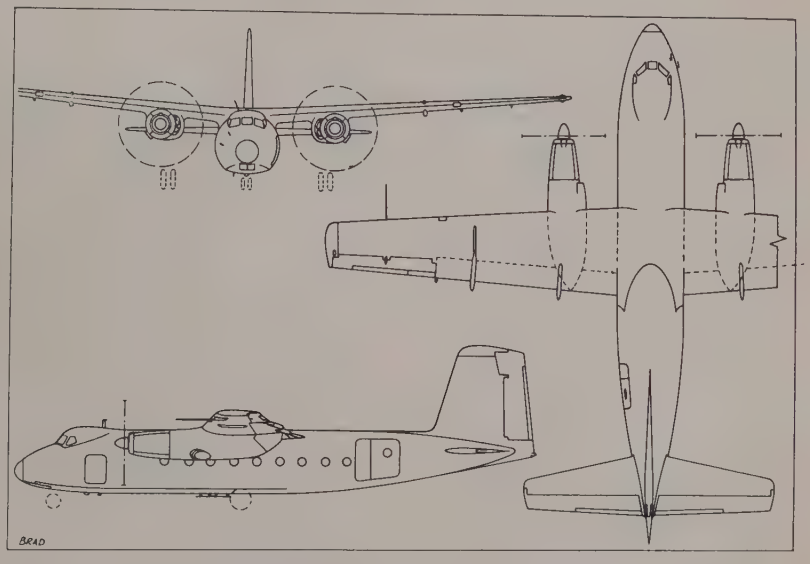
TYPE.—Medium-range Feeder-line or General Purpose Transport.

WINGS.—High-wing cantilever monoplane. Dihedral 4°. Chord 12 ft. 0 in. (3.66 m.) at root, 6 ft. 3 in. (1.91 m.) at tip. Centre-section, which carries the engines, is of sandwich construction, having double skinning separated by metal corrugation and no conventional spar structures. Outer wings have two-spar all-metal stressed-skin structure. Slotted flaps inboard of ailerons. Thermal de-icing. Total area of ailerons 59.4 sq. ft. (5.52 m.²). Total area of flaps 162 sq. ft. (15.06 m.²). Gross wing area 886 sq. ft. (82.4 m.²).

FUSELAGE.—All-metal stressed-skin structure.

TAIL UNIT.—Cantilever monoplane type with single fin and rudder. All-metal structure. Thermal de-icing. Areas: vertical surfaces 193 sq. ft. (17.93 m.²), tailplane 252 sq. ft. (23.41 m.²), elevators 71.13 sq. ft. (6.61 m.²). Span of tailplane 36 ft. 9½ in. (11.22 m.).

LANDING GEAR.—Retractable tricycle type. Hydraulic actuation. Main units retract forward into engine nacelles. All units have twin wheels. Main wheels size 34 × 11.75-14. Nose-wheels size 23 × 7.25-10.



The Handley Page Dart Herald "Branchliner."



The Handley Page Dart Herald (two Rolls-Royce Dart turboprop engines).



The Handley Page Dart Herald (two Rolls-Royce Dart turboprop engines).

Maximum tyre pressure 60 lb./sq. in. (4.218 kg./cm.²). Nose-wheels are steerable through an angle of 110° by hydraulics from the control column. They are also self-centering and fully-castoring. Hydraulic disc-type wheel brakes on main units. Wheelbase 25 ft. 10 in. (7.87 m.). Track (between centre-lines of oleo legs) 22 ft. (6.71 m.).

POWER PLANT.—Two Rolls-Royce Dart Mk. 527 (R.Da.7) turboprop engines, each giving 1,910 s.h.p. plus 502 lb. (228 kg.) s.t. (=2,105 e.h.p.) for take-off. Rotol four-blade fully-feathering constant-speed airscrews, diameter 12 ft. 6 in. (3.81 m.). One fuel tank of 350 Imp. gallons (1,591 litres) and one of 150 Imp. gallons (682 litres) in each wing. Total fuel capacity 1,000 Imp. gallons (4,546 litres). Oil capacity 6 Imp. gallons (27.3 litres).

ACCOMMODATION.—Flight compartment in nose for crew of two, with separate entry door. Duplicate flying controls and flight instruments. Main cabin may be arranged to seat up to 43 passengers in forward or backward-facing seats in high-density versions. Standard seating for 36 passengers, with galley, etc. Entire accommodation pressurised with a maximum differential of 3.35 lb./sq. in. (0.235 kg./cm.²), equivalent to a cabin altitude of 6,300 ft. (1,922 m.) when flying at 15,000 ft. (4,570 m.). Passenger entry door at rear end of cabin on port side, with adjacent door giving access to standard baggage and freight compartment aft. Overall size of doorway 5 ft. 4 in. high, 5 ft. 5 in. wide (1.62×1.65 m.). A non-stressed removable bulkhead can be used to permit various combinations of passenger/freight loads, the various bulkhead stations being in the forward part of the cabin. All seats may be removed to convert entire cabin for freight carrying. Seat attachments serve as tie-down points. Passenger and freight loading door sills 3 ft. 6 in. (1.06 m.) from ground. Cabin is 43 ft. 8 in. (13.31 m.) long, 6 ft. 3 in. (1.9 m.) high and 8 ft. 6 in. (2.59 m.) wide. Cabin volume is 2,152 cub. ft. (60.90 m.³).

DIMENSIONS.—
Span 94 ft. 9½ in. (28.89 m.).
Length 71 ft. 11 in. (21.92 m.).
Height over tail 22 ft. 4 in. (6.81 m.),

WEIGHTS.—
Basic equipped weight (36-seater) 22,808 lb. (10,345 kg.).
Max. payload (36-seater) 10,160 lb. (4,608 kg.).
Max. take-off and landing weight 37,000 lb. (16,783 kg.).
Max. zero fuel weight (36-seater) 32,968 lb. 14,954 kg.).

PERFORMANCE.—
Speed at recommended cruise power (13,800 r.p.m.) at 36,000 lb. (16,329 kg.) A.U.W., I.S.A. conditions, at 15,000 ft. (4,575 m.) 275 m.p.h. (443 km.h.).
Rate of climb at 10,000 ft. (3,050 m.) at max. A.U.W. 1,030 ft./min. (314 m./min.).
Time to 10,000 ft. (3,050 m.) 6.7 min.
Service ceiling 29,500 ft. (9,000 m.).
Take-off distance to 50 ft. (15.25 m.) 725 yds. (663 m.).
Take-off distance to 50 ft. (15.25 m.), with one engine failing at critical safety speed 1,390 yds. (1,272 m.).
Landing distance from 50 ft. (15.25 m.) 730 yds. (668 m.).

RANGES (at 275 m.p.h.=443 km.h. at 15,000 ft. 4,575 m.).—
With max. payload (10,160 lb. = 4,608 kg.) 703 miles (1,131 km.).
With full tanks and 6,200 lb. (2,812 kg.) payload 1,430 miles (2,300 km.).

THE HANDLEY PAGE HASTINGS.

The Hastings is a general purpose long-range transport which is in service in the Royal Air Force and the Royal New Zealand Air Force. Its rôles include those of freighter, paratroop transport, ambulance, troop-carrier, supply dropper, jeep carrier and glider tug.

The following are the production versions of the Hastings :—

Hastings C. Mk. 1. Four Bristol Hercules 10i engines. Initial production version. First production C. Mk. 1 flew on April 25, 1947. Tailplane mounted above centre-line of fuselage. Original total internal fuel capacity 2,560 Imp. gallons (11,650 litres). All Mk. 1's have now been modified to Mk. 2 standard, including provision for extra tankage, and are now known as C. Mk. 1A.

Hastings Met. Mk. 1. Specially equipped version of the C. Mk. 1 for long-range meteorological reconnaissance.

Hastings C. Mk. 2. Four Bristol Hercules 106 engines. Tailplane lowered to centre-line of fuselage and increased in area to 442 sq. ft. (41.1 m.²); spring-tabs fitted in elevators. Extra fuel tanks in outer wings increase total tankage to 3,172 Imp. gallons (14,420 litres). Crew rest station replaced by air quartermaster post. Max. payload increased to 20,311 lb. (9,221 kg.).

Hastings C. Mk. 3. Four Bristol Hercules 737 engines, with single-stage blowers. Basically similar to the C. Mk. 2 apart from engine change. Four supplied to the Royal New Zealand Air Force.

Hastings C. Mk. 4. V.I.P. version of C. Mk. 2. De luxe accommodation for four V.I.P.'s and staff. All seats face aft. Four delivered to R.A.F. Transport Command.

A full structural description of the Hastings has appeared in previous editions of "All the World's Aircraft."

DIMENSIONS.—
Span 113 ft. (34.46 m.).
Length 81 ft. 8 in. (24.9 m.).
Height 22 ft. 6 in. (6.86 m.).

WEIGHTS.—
Basic equipped weight (freighter) 48,427 lb. (21,986 kg.).
Max. payload 20,311 lb. (9,221 kg.).



The Handley Page Hastings C. Mk. 2 Transport (four 1,675 h.p. Bristol Hercules 106 engines).

Payload 10,000 lb. (4,585 kg.) for 3,000 mile (4,827 km.) range.
Max. take-off weight 80,000 lb. (36,320 kg.).
Max. landing weight 74,000 lb. (33,570 kg.).
PERFORMANCE.—
Max. speed 348 m.p.h. (560 km.h.) at 22,200 ft. (6,770 m.).
Max. weak mixture cruising speeds 291 m.p.h. (468 km.h.) at 15,200 ft. (4,630 m.) and 302 m.p.h. (486 km.h.) at 23,600 ft. (7,190 m.).
Rate of climb 890 ft./min. (272 m./min.).
Climb to 20,000 ft. (6,100 m.) 26 minutes.
Service ceiling 26,500 ft. (8,077 m.).
Range with max. payload 1,690 miles (2,720 km.).
Max. range 4,250 miles (6,850 km.).
Take-off distance to 50 ft. (15.2 m.) 1,586 yds. (1,450 m.).
Landing distance from 50 ft. (15.2 m.) 1,430 yds. (1,308 m.).

HAWKER



The Hawker Hunter F. Mk. 6 Single-seat Interceptor (Rolls-Royce Avon Series 200 engine).

HAWKER AIRCRAFT, LTD.

REGISTERED OFFICE: CANBURY PARK ROAD, KINGSTON-ON-THAMES, SURREY.

WORKS AND AERODROMES: CANBURY PARK ROAD AND RICHMOND ROAD, KINGSTON - ON - THAMES; DUNSFOLD, SURREY.

Chairman: Sir Frank Spencer Spriggs, K.B.E., Hon.F.R.Ae.S.

Directors: Sir Thomas Sopwith, C.B.E., Hon. F.R.Ae.S.; A. N. Spriggs, O.B.E., M.I.P.E. (Managing Director); J. T. Lidbury, J.P. (General Manager); Sir Sydney Camm, C.B.E., F.R.Ae.S. (Chief Designer); E. H. Jefferson; J. D. Stranks, A.F.R.Ae.S. (Works Director).

Secretary: E. G. Rubython.

Hawker Aircraft, Ltd., was incorporated in 1933 as successor to the H. G. Hawker Engineering Co., Ltd., which was formed in 1920 following the voluntary liquidation of the famous Sopwith concern.

The Hawker company produced during the last war a distinguished line of single-seat fighters, of which the Hurricane, the Typhoon, and the Tempest were the best known. From the Tempest were developed the Fury and Sea Fury, both of which were produced in numbers after the war.

The latest Hawker fighter is the Hunter which is in production for the Royal Air Force, is being built under licence in Holland and Belgium and has also been exported to Denmark, Iraq, India, Peru, Sweden and Switzerland.

The Hunter F.Mk. 6 interceptor is a standard service fighter with squadrons of the Royal Air Force at home and overseas, while the T. Mk. 7 is now in service in the R.A.F. and the T. Mk. 8 with the Royal Navy. The trainer version is also on order for Denmark, Holland and India.

The development and production of the Sea Hawk is now the responsibility of Sir W. G. Armstrong Whitworth Aircraft, Ltd., a sister company in the Hawker Siddeley Group.

Recent reports mention work by Hawker Aircraft on STOL applications to a tactical light aircraft for possible future use by NATO forces in the 1960's.

THE HAWKER P.1121.

A single-seat supersonic strike fighter designated the P.1121 has been designed as a private venture by the Hawker company. No details are available, except that it is intended to be powered by a de Havilland Gyron turbojet.

Although completion of the prototype has been deferred, the project was still active in 1958.

THE HAWKER HUNTER.

The Hunter is in production for the Royal Air Force and has been supplied to the Governments of Denmark, Iraq, India, Peru, Sweden and Switzerland.

Under American "off-shore" purchasing arrangements licences for the manufacture of the Hunter have been signed with the Dutch and Belgian Governments. Production in Holland is by Fokker and Aviolanda, and in Belgium by Avions Fairey and SABCA.

The following versions of the Hunter have so far been announced:—

Hunter F. Mk. 1. One Rolls-Royce Avon RA.7 Series turbojet engine. Two prototypes were built, the first (WB188) flying for the first time on July 20, 1951, while a second (WB195) made its first flight in May, 1952. The first production F.Mk. 1 (WT555) flew on November 30, 1952. Production complete.

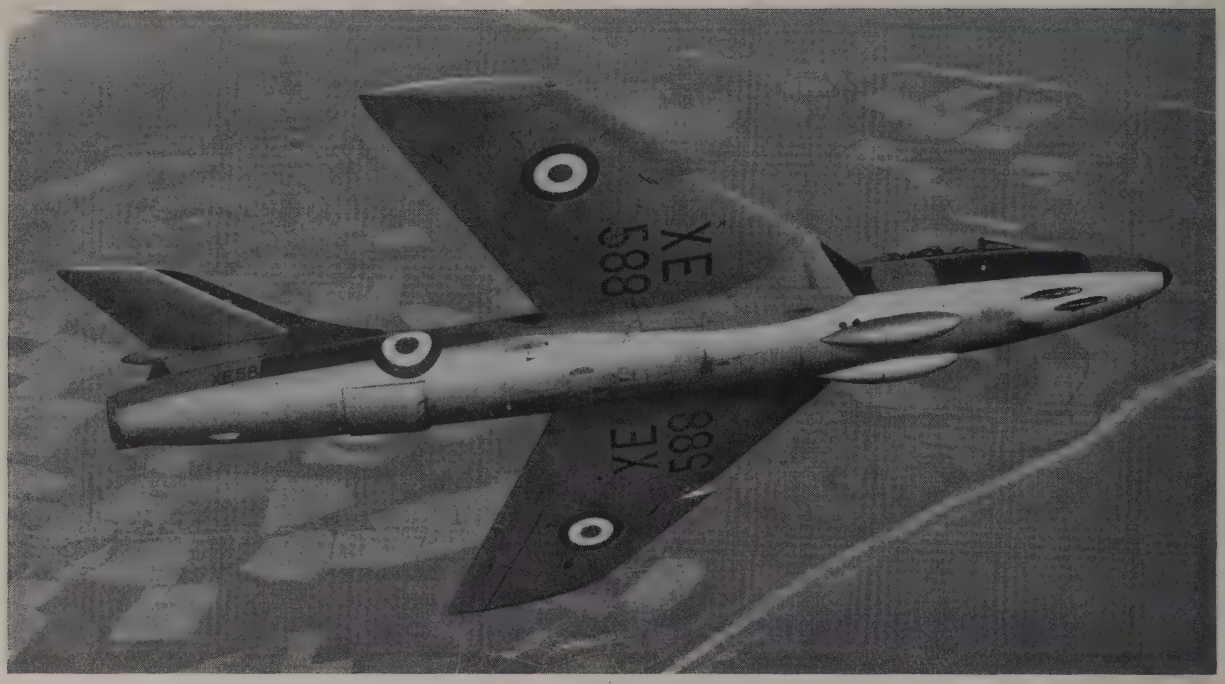
Hunter F. Mk. 2. One Armstrong Siddeley Sapphire ASSa.6 turbojet engine. Hawker-built prototype (WB202) made its first flight on November 30, 1952. Production aircraft built by Sir W. G. Armstrong Whitworth Aircraft, Ltd. Production complete.

Hunter F. Mk. 3. One Rolls-Royce Avon RA.7R turbojet engine with afterburner. Only one, converted from prototype F. Mk. 1 (WB188). In September, 1953, this aircraft set up World's Speed Records over the 3-kilometre straight course and the 100-kilometre closed-circuit course at 727.6 m.p.h. (1,171 km.h.) and 709 m.p.h. (1,141.4 km.h.) respectively.

Hunter F. Mk. 4. One Rolls-Royce Avon Mk. 113 or 115 turbojet engine. Mk. 1 with later modifications, including increased internal fuel capacity and provision for underwing stores and drop-tanks. Has also been adapted for photographic reconnaissance duties. Production complete.



The Hawker Hunter F. Mk. 6 Single-seat Interceptor armed with two D.H. Firestreak missiles.



The Hawker Hunter F. Mk. 6 Single-seat Interceptor (Rolls-Royce Avon Series 200 turbojet engine).

Hunter F. Mk. 5. One Armstrong Siddeley Sapphire ASSa.6 turbojet. Development of Mk. 2 with modifications introduced in Mk. 4. Built by Sir W. G. Armstrong Whitworth Aircraft, Ltd. Production complete.

Hunter F. Mk. 6. One Rolls-Royce Avon (Series 200) RA.28 turbojet (10,000 lb. = 4,540 kg. s.t.). Development of the Mk. 4. Modifications include fitting of extended, or "dog-tooth" leading-edge panels and provision for four pylons under wings for greater range of external stores. During 1957-58 a number of Mk. 6's were presented to the Iraqi Air Force by the British Government.

Hunter T. Mk. 7. Two-seat side-by-side version having wider forward fuselage to accommodate new cockpit. Martin Baker Mk. 4 lightweight ejector seats. Armament consists of one 30 mm. Aden cannon in fairing under forward fuselage and offset to starboard. Drag parachute in fairing above jet pipe. First prototype (XJ615), basically a Mk. 4, flown on July 8, 1955. Second prototype (XJ627) based on Mk. 6, made its first flight on November 17, 1956. First production T. Mk. 7 flew in October, 1957. A number of T. Mk. 7 trainers powered by Rolls-Royce Avon Mk. 120 Series engines ordered by Netherlands Government and deliveries began in 1958.

Hunter T. Mk. 8. Naval version of T. Mk. 7 ordered by Royal Navy. Rolls-Royce Avon RA.21 engine. Modifications include fitting of airfield arrester gear for training purposes. Prototype flew in March, 1958.

Hunter F. Mk. 50. Mk. 4 supplied to the Royal Swedish Air Force. Its Swedish designation is J 34. Deliveries began in August, 1955. 120 delivered. Production complete.

Hunter F. Mk. 51. Mk. 4 supplied to the Royal Danish Air Force. Deliveries began in January, 1956. 30 delivered. Production complete.

Hunter F. Mk. 52. Mk. 4 supplied to the Peruvian Air Force. Deliveries of 16 aircraft began in February, 1956, and now completed.

Hunter T. Mk. 53. Mk. 7 trainer (based on Mk. 4) supplied to the Royal Danish Air Force.

Hunter F. Mk. 56. Mk. 6 ground attack fighter, powered by Rolls-Royce Avon 200 Series engine, supplied to India. 160 aircraft ordered and deliveries began in October, 1957.

Hunter F. Mk. 58. Mk. 6 ground attack fighter, powered by Rolls-Royce Avon 200 Series engine, supplied to Switzerland. 100 aircraft ordered and deliveries began in April, 1958. Modifications include installation of landing parachute above tail-pipe.

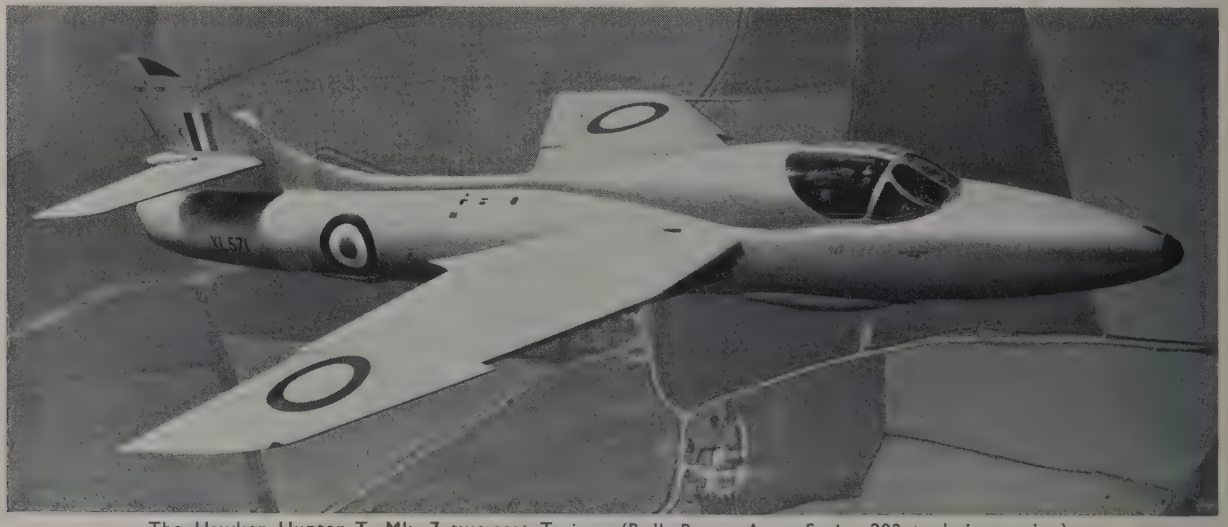
Hunter T. Mk. 66. Mk. 7 trainer (based on Mk. 6) powered by Rolls-Royce Avon 200 Series engine supplied to India.

All versions of the Hunter are supersonic in shallow dives at height.

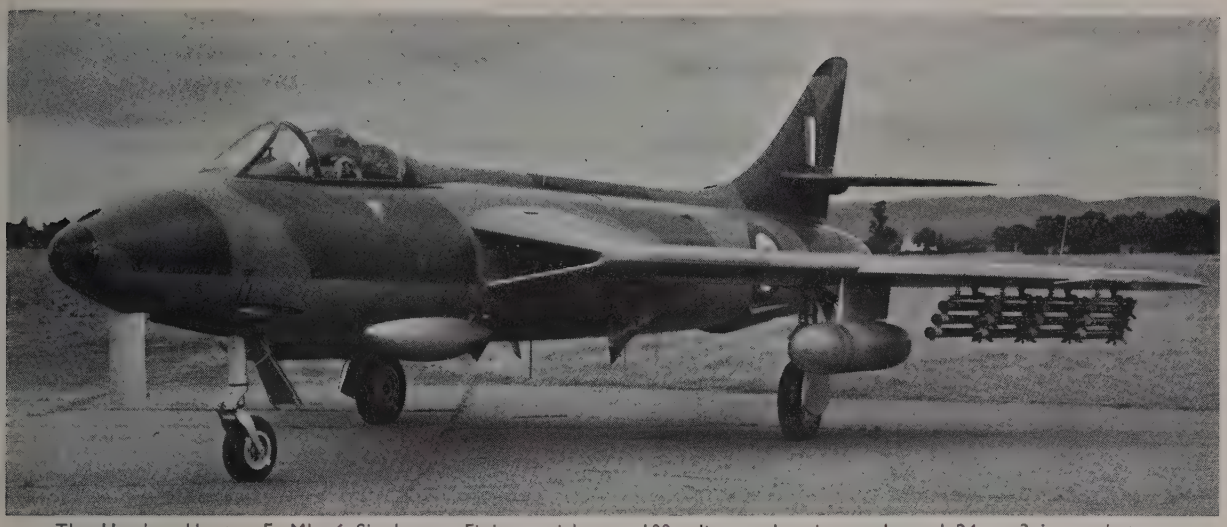
TYPE.—Single-seat Interceptor Fighter.

WINGS.—Mid-wing cantilever monoplane. Sweepback at 25% chord 40°. Aspect ratio 3.3. Thickness/chord ratio 8.5%. All-metal structure. "Dog-tooth" leading-edge, giving greater chord on outer wings of late Mk. 6 and 7 aircraft. Hydraulically-operated split flaps between powered ailerons and fuselage. Gross wing area 349 sq. ft. (32.4 m.²).

FUSELAGE. — All - metal semi - monocoque structure. In three structural units, nose section enclosing cockpit, armament pack and nose-wheel; centre section with integral wing roots, engine mountings and intake ducts; and detachable rear fuselage with integral fin base and removable jet-pipe and tail-cone unit. Air brake in form of a hinged flap conforming to curvature of underside of rear fuselage.



The Hawker Hunter T. Mk. 7 two-seat Trainer (Rolls-Royce Avon Series 200 turbojet engine).



The Hawker Hunter F. Mk. 6 Single-seat Fighter with two 100-gallon underwing tanks and 24 × 3 in. rockets.

TAIL UNIT.—All surfaces swept, the tailplane being mounted on fin. Powered elevators. Aerodynamic tab on rudder. All-metal structure.

LANDING GEAR.—Retractable tricycle type. Main wheels raised inward into wing roots, nose-wheel forward into front fuselage. Hydraulic actuation with emergency pneumatic system. Track 14 ft. 9 in. (4.50 m.).

POWER PLANT.—One Rolls-Royce Avon (Mks. 1, 4, 6 and 7) or Armstrong Siddeley Sapphire (Mks. 2 and 5) axial-flow turbojet engine in centre fuselage, with air intakes in thickened wing-roots and jet exit in end of fuselage beneath tail-unit. Normal fuel carried internally. High-pressure refuelling valve in port main wheel bay. Auxiliary fuel may be carried in two or four 100 Imp. gallon (455 litre) pylon-mounted asbestos phenolic underwing tanks. Plessey propyl-nitrate liquid starter in Mk. 6, cartridge starter in earlier marks.

ACCOMMODATION.—(Fighter version) Pressurised and air-conditioned cockpit with sliding jettisonable canopy. Martin Baker ejection seat with combined hood-jettisoning and seat ejection sequencing device initiated by pulling down ejector seat blind.

ACCOMMODATION (Mk. 7 Trainer).—Pressurised cockpit for two side-by-side with dual controls. Two Martin Baker Mk. 4 automatic light-weight ejector seats.

ARMAMENT (Fighter version).—Four 30 mm. Aden cannon (100 r.p.g.) in self-contained package in underside of fuselage nose. Gun-pack can be winch-lowered for re-arming, servicing, etc. Automatic gun-ranging radar in front fuselage with scanner in nose radome, and gyro gun-sight. Provision under wings for the following stores: 36 × 3 in. rockets, or two 1,000 lb. (454 kg.) streamlined bombs, or practice bomb carriers or four 100 gallon asbestos phenolic fuel tanks, or any combination of the foregoing. Can also be adapted to carry two Fairey Fireflash or de Havilland Firestreak guided missiles, one under each wing.

ARMAMENT (Mk. 7 Trainer).—One 30 mm. Aden cannon in streamline fairing beneath cockpit. Two gun-sights, one for each occupant.

DIMENSIONS (Mks. 1, 2, 4, 5 and 6).—
Span 33 ft. 8 in. (10.26 m.).
Length 45 ft. 10½ in. (13.99 m.).
Height 13 ft. 2 in. (4.26 m.).

DIMENSIONS. (Mk. 7).—
Span 33 ft. 8 in. (10.26 m.).
Length 48 ft. 10½ in. (14.91 m.).
Height 13 ft. 2 in. (4.26 m.).

HAWKER SIDDELEY

HAWKER SIDDELEY GROUP, LTD.

GROUP HEADQUARTERS: 18, ST. JAMES'S SQUARE, LONDON, S.W.1.

Directors: Sir Thomas Sopwith, C.B.E., Hon. F.R.Ae.S. (Chairman), Sir Roy Dobson, C.B.E., Hon. F.R.Ae.S., J.P., (Managing Director), H. Burroughes, F.R.Ae.S. (Deputy Managing Director), H. A. Meredith, O.B.E., H. T. Chapman, C.B.E., F.R.Ae.S. M.I.Mech.E., J. F. Robertson, C.A., Sir Arnold Hall, F.R.S., M.A., Hon. A.C.G.I., F.R.Ae.S., H. G. Herrington, C.B.E., F.R.Ae.S., G. C. R. Eley, C.B.E. and Crawford Gordon, Jr., O.B.E.

The Hawker Siddeley Group, which was formed in 1935, is the controlling organisation of Hawker Aircraft, Ltd., Gloster Aircraft Co., Ltd., A. V. Roe & Co., Ltd., Sir W. G. Armstrong Whitworth Aircraft Ltd., Armstrong Siddeley Motors, Ltd., Air Service Training Ltd. and High Duty Alloys, Ltd.; and in Canada, A. V. Roe Canada, Ltd., Avro Aircraft, Ltd., Orenda Engines, Ltd., Canadian Steel Improvement, Ltd., Canadian Car Co., Ltd. and PSC Applied Research Ltd., and a large number of other subsidiary and associate companies whose work is not directly related to aircraft.

Products of the aircraft and aero-engine manufacturing components of the Group will be found under their individual names in this and the Engine Sections of this book.

HUNTING

HUNTING AIRCRAFT, LTD.

HEAD OFFICE AND WORKS: LUTON AIRPORT, LUTON, BEDFORDSHIRE.

Directors: P. Ll. Hunting (Chairman); G. L. Hunting; C. P. M. Hunting, B.A., A.C.A.; W. A. Summers, C.B.E. (Managing); R. R. S. Cook; L. C. Hunting, M.A.; K. D. Morgan (Secretary); F. W. Buglass, M.I.P.E. (Works); and F. H. Pollicutt, F.R.Ae.S. (Technical).

The Percival Aircraft Company was formed in 1932. It was re-organized as Percival Aircraft Ltd. in 1937, and the works were moved from Gravesend to Luton. In 1944 the company became part of the Hunting Group and a branch office was opened at Toronto, Canada, in 1946. The name was changed to Hunting Percival Aircraft, Ltd. in 1954 and to Hunting Aircraft, Ltd. in 1957.

In 1958 Hunting participated in the formation of a consortium with Fairey Aviation Co., Ltd. and de Havilland Holdings, Ltd. to produce the D.H. 121 jet airliner which has been chosen by B.E.A. The new company is known as the Aircraft Manufacturing Co., Ltd. (Airco) (which see).

The current Hunting productions are the Provost, the Jet Provost, the Pembroke and the President.

The Provost, a side-by-side two-seat basic trainer, has now replaced the Prentice in all basic flying schools in the R.A.F. and is also in service in the Air Forces of Rhodesia, Burma, Eire, Iraq and Sudan.

Initial evaluation version of the Jet Provost have been in service with the R.A.F. for the past three years. The Mk. 3 is now in full production for the R.A.F. in which it will replace its piston-engined predecessor, the Provost, from the latter part of 1958 onwards.

The Pembroke is in service in the Royal Air Force, the Royal Rhodesian Air Force, the Belgian Air Force, the Finnish Air Force, the Swedish Air Force, the Royal Danish Air Force and the West German Air Force.

The civil version of the Pembroke is known as the President.

THE HUNTING P.84 JET PROVOST.

The prototype Jet Provost Mk. 1 powered by an Armstrong Siddeley Viper ASV.5 engine (1,640 lb. = 745 kg. s.t.) flew for the first time on June 26, 1954. This aircraft, of which a small pre-production batch was ordered by the Royal Air Force for evaluation by Flying Training Command, was a direct development of the Leonides-engined Provost and made use of as many of the structural



The Hunting Jet Provost T. Mk. 3 (Armstrong Siddeley Viper engine).

components of that aircraft as possible. In parallel with its service evaluation as a trainer, considerable development of the aircraft was undertaken, which resulted in the production of a Mk. 2 version, which had a redesigned rear fuselage, a shorter landing gear, hydraulic instead of pneumatic services and the higher-powered Viper ASV.8 engine (1,750 lb.=795 kg. s.t.). The Mk. 2, of which a small number was also ordered, has served as the prototype for the Mk. 3.

One Mk. 2 (G-AOUS) has been fitted experimentally with a Viper ASV.11 engine (2,460 lb.=1,116 kg.) s.t.

The Mk. 3 has the same power-plant, shortened landing gear and hydraulic services as the Mk. 2 but is equipped with Martin Baker lightweight ejector seats, clear-view front windscreen and wing-tip fuel tanks.

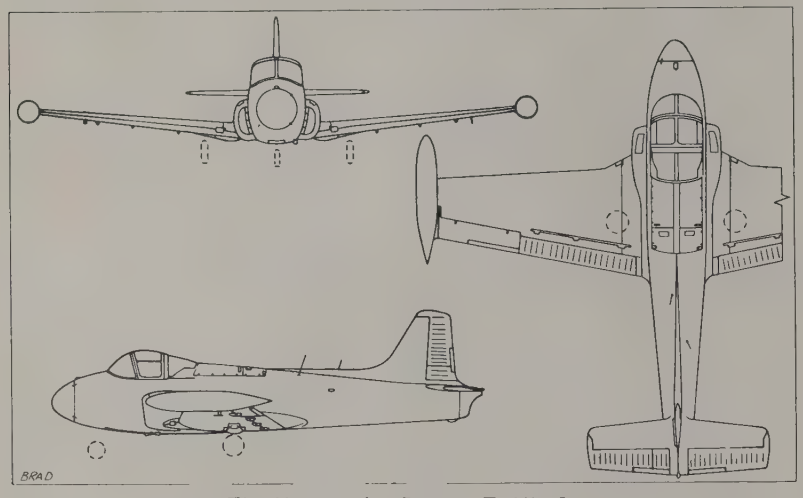
Following the success of its eighteen months' evaluation in the R.A.F., the Jet Provost has been adopted for *ab initio*/basic jet training up to the advanced flying stage, and a substantial production order for the Mk. 3 has been placed. The Royal Air Force is the first service in the World to adopt the principle of "all-through" jet training.

The description and specification which follow refer to the Jet Provost T. Mk. 3.



The Hunting Jet Provost T. Mk. 3 (Armstrong Siddeley Viper engine).

placed blind-flying panel is used. For armament training two .303 in. machine-guns can be fitted in nose of fuselage, plus two standard reflector sights, one in front of each seat. A variety of underwing stores could be carried such as 4×60-lb. (27 kg.) rockets and 8×25-lb. (11 kg.) practice bombs.



The Hunting Jet Provost T. Mk. 3.

TYPE.—Two-seat Jet Primary and Basic Trainer.

WINGS.—Basically same as for P.56 Provost. Aspect ratio 5.78. Chord 7 ft. 8 in. (2.33 m.) at root, 4 ft. 4 in. (1.31 m.) at tip. Dihedral 6°. Incidence 2.5° at root, 0.5° at tip. Air brakes on wings at rear spar position ahead of flaps. Both air brakes and flaps are hydraulically-operated. Total flap area 25.72 sq. ft. (2.39 m.²). Total aileron area 18.70 sq. ft. (1.73 m.²). Gross wing area 213.7 sq. ft. (19.80 m.²).

FUSELAGE.—All-metal structure.

TAIL UNIT.—Same as for P.56 Provost.

LANDING GEAR.—Retractable nose-wheel type. Dowty pneumatic retraction. Dunlop wheels and hydraulic brakes. Wheelbase 10 ft. (3.05 m.). Track 10 ft. 8.7 in. (3.23 m.).

POWER PLANT.—One Armstrong Siddeley Viper ASV.8 axial-flow turbojet engine (1,750 lb.=794 kg. s.t.) in fuselage aft of cockpit. "Elephant-ear" intakes on each side of forward fuselage and jet exit at rear of fuselage aft of tailplane. Normal internal capacity (three tanks in each wing) 186 Imp. gallons (846 litres). Two 50 Imp. gallon (227 litres) wing-tip tanks may be fitted to order. Oil capacity 14 pts. (8 litres).

ACCOMMODATION.—Enclosed cockpit in front of leading-edge of wings seating two side-by-side with dual controls. Martin-Baker Mk. 4 lightweight ejector seats. Layout of cockpit similar to that of P.56 Provost T.Mk. 1 except that a single centrally-

DIMENSIONS.—
Span over tanks 36 ft. 11 in. (11.25 m.).
Length 32 ft. 5 in. (9.88 m.).
Height 10 ft. 2 in. (3.11 m.).

WEIGHTS.—
Weight loaded (full internal fuel) 6,195 lb. (2,810 kg.).
Weight loaded (max. fuel including tip tanks) 7,092 lb. (3,200 kg.).

PERFORMANCE (at 6,195 lb. = 2,810 kg. A.U.W.).—
Max. level speed 326 m.p.h. (522 km.h.) at 25,000 ft. (7,620 m.).
Max. design speed 437 m.p.h. (705 km.h.) up to 10,000 ft. (3,050 m.).
Stalling speed 75 m.p.h. (120 km.h.).
Rate of climb at S/L. 2,400 ft./min. (12.2 m./sec.).
Rate of climb at 30,000 ft. (9,150 m.) 500 ft./min. (2.54 m./sec.).
Time to 10,000 ft. (3,050 m.) 5.0 min.
Time to 20,000 ft. (6,100 m.) 11.5 min.
Time to 30,000 ft. (9,150 m.) 23.0 min.
Rate of roll 155°/sec.
Range at 30,000 ft. (9,150 m.) (internal fuel only) 397 miles (639 km.).
Range at 25,000 ft. (7,620 m.) (tip tanks full) 565 miles (910 km.).
Endurance at 30,000 ft. (9,150 m.) (internal fuel only) 1.64 hours.
Endurance at 30,000 ft. (9,150 m.) (tip tanks full) 2.6 hours.
T.O. distance to 50 ft. (15.25 m.) 1,990 ft. (606 m.).

THE HUNTING P.56 PROVOST.

The P.56 trainer was designed to Specification T.16/48 to meet R.A.F. requirements. Three prototypes were built, one fitted with the Armstrong Siddeley Cheetah 18 engine and the other two with the Alvis Leonides engine. The first (Cheetah-engined) prototype flew for the first time on February 23, 1950.

As the result of comprehensive trials the Leonides-engined P.56 was selected as the standard R.A.F. basic trainer under the designation Provost T. Mk. 1.

The armed version of the Provost for weapon training can be equipped with the following armament: 2 × .303-in. machine-guns; 1 camera-gun and 2 × 250-lb. bombs; or 8 × 25-lb. bombs; or 8 × 25-lb. bombs and 4 × 60-lb. R.P.; or 6 × 60-lb. R.P.

The following are the designations of the Provosts which have been exported :—



The Hunting Provost T. Mk. 53 for the Burma Air Force.

Provost T. Mk. 51. T. Mk. 1 (unarmed) supplied to Eire Air Corps.

Provost T. Mk. 52. Armed version supplied to the Royal Rhodesian Air Force.

Provost T. Mk. 53. Armed version supplied to the Eire Air Corps, the Burma Air Force, the Iraqi Air Force and the Sudan Air Force.

The following description applies specifically to the Provost T. Mk. 1.

TYPE.—Two-seat Basic Trainer.

WINGS.—Cantilever low-wing monoplane. Wing section NACA 23015 (mod.) at root. NACA 4412 (mod.) at tip. Aspect ratio 5.78. Dihedral 6°. Incidence 3°. All-metal stressed skin construction. Metal covered ailerons and trim-tabs. Pneumatically-operated slotted flaps. Total flap area 18.94 sq. ft. (1.74 m.²). Gross wing area 214 sq. ft. (20 m.²).

FUSELAGE.—All-metal monocoque structure.

TAIL UNIT.—Cantilever monoplane type. All-metal one-piece tailplane, interchangeable elevators, fin and rudder, the fixed surfaces covered with smooth and movable surfaces with fluted alloy skin. Trim and balance tabs in elevators, combined trim and balance tab in rudder. Span of tailplane 13 ft. 6 in. (4.1 m.). Total horizontal area 48.6 sq. ft. (4.51 m.²). Total vertical area 35.09 sq. ft. (3.26 m.²).

LANDING GEAR.—Fixed tail-wheel type. British Messier oleo-pneumatic shock-absorbers. Differential pneumatic brakes. Dowty liquid-spring tail-wheel strut. Track 11 ft. 1⅛ in. (3.38 m.).

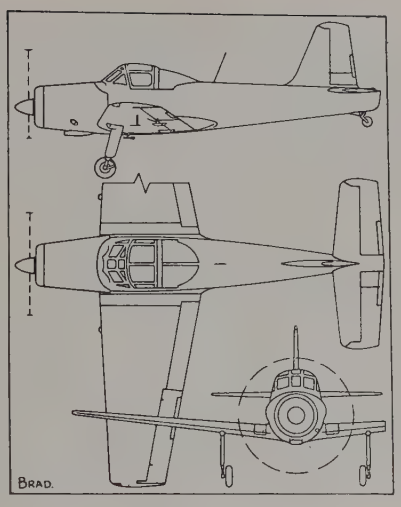
POWER PLANT.—One 550 h.p. Alvis Leonides 25 nine-cylinder air-cooled geared and supercharged radial engine. Three-blade metal constant-speed airscrew, 9 ft. (2.74 m.) diameter. Fuel capacity 66 Imp. gallons (300 litres).

ACCOMMODATION.—Crew of two in enclosed cockpit. Instructor (on starboard) and pupil sit side-by-side, with full dual controls and dual instrument panels. Sliding canopy is mechanically-operated and jettisonable.

DIMENSIONS.—
Span 35 ft. 2 in. (10.9 m.).
Length 29 ft. (8.85 m.).
Overall height (tail up) 12 ft. (3.66 m.).

WEIGHTS AND LOADINGS.—
Weight empty (equipped) 3,350 lb. (1,521 kg.).
Crew (2) 400 lb. (182 kg.).
Fuel and oil 529 lb. (240 kg.).
Weight loaded 4,400 lb. (2,000 kg.).
Wing loading 20.6 lb./sq. ft. (100.5 kg./m.²).
Power loading 8.0 lb./h.p. (3.63 kg./h.p.).

PERFORMANCE.—
Max speed 195 m.p.h. (312 km.h.) at sea level and 200 m.p.h. (322 km.h.) at 2,300 ft. (700 m.).
Max. continuous cruising speed 194 m.p.h. (310 km.h.) at 7,900 ft. (2,410 m.).
Max. economical cruising speed 177 m.p.h. (283 km.h.) at 11,500 ft. (3,510 m.).
Stalling speed, flaps down 67 m.p.h. (108 km.h.).
Initial rate of climb 2,200 ft./min. (11.2 m./sec.).
Rate of climb at 5,000 ft. (1,525 m.) 1,870 ft./min. (9.5 m./sec.).
Climb to 5,000 ft. (1,525 m.) 3.3 minutes.
Climb to 10,000 ft. (3,050 m.) 7.0 minutes.
Rate of roll (per second) 90 degrees.



The Hunting Provost.

Service ceiling 22,500 ft. (6,860 m.).
Take-off to 50 ft. (15.2 m.), grass surface 283 yds. (260 m.).
Landing run 265 yds. (242 m.).
Duration (at economical weak cruise) 4 hrs.

THE HUNTING P.66 PEMBROKE.

The Pembroke is an eight-seat communications and light transport aircraft which is in service with the Royal Air Force. It is adaptable for freighting, long-range ferrying, casualty evacuation and photographic survey duties.

Fixed fittings in the cabin are provided for eight 15G rearward-facing seats, for stretchers or for lashing down cargo. The main cabin door is removable for parachuting freight and equipment.

A fixed supply of oxygen is provided for the crew, with portable oxygen equipment for the passengers.

Two versions of the Pembroke are in service with the Royal Air Force, as follows :—

Pembroke C. Mk. 1. Standard eight-seat communications version.

Pembroke C. (P.R.) Mk. 1. Basically similar to C. Mk. 1, but with provision for vertical and sideways-facing oblique cameras in cabin for dual rôle as photographic survey aircraft.

The Pembroke in service with the Royal Rhodesian Air Force is identical to the R.A.F. Pembroke C. Mk. 1 except that de-icing equipment is not fitted.

The following are the designations of the versions of the Pembroke which have been exported to Belgium, Sweden, Finland, Denmark and West Germany.

Pembroke C. Mk. 51. Supplied to the Belgian Air Force. Basic accommodation for crew of 4 and 6 passengers. Provided with clear-view photographic sighting nose, together with optically flat window in nose compartment and vertical and oblique camera apertures in main cabin for air survey and photography. Removable dual controls to permit aircraft to be used for twin-engine pilot training, and with two-stage amber screening for cloud and night flying training.

Pembroke C. Mk. 52. Supplied to Royal Swedish Air Force. R.S.A.F. designation: Tp. 81. Basically similar to C. Mk. 1 but with accommodation for crew of 2 and 10 passengers.

Pembroke C. Mk. 52/2. Supplied to Royal Danish Air Force. Majority are of standard 2-crew 10-passenger communications/training version similar to C. Mk. 52, but small number supplied as V.I.P. aircraft with luxury accommodation for six passengers.

Pembroke C. Mk. 53. Supplied to Finnish Air Force. Basic accommodation for crew of 3 and 7 passengers, and similar to C. Mk. 51 with facilities and equipment for air survey and photography, etc.

Pembroke C. Mk. 54. Supplied to West German Air Force. Basic accommodation for crew of 2 and 10 passengers, with built-in facilities for ambulance, survey, aircrew-training and freighting duties. 33 ordered.

TYPE.—Twin-engined Communications and Training monoplane.

WINGS.—High-wing cantilever monoplane. NACA 23017 wing section. Aspect ratio 10.4. Chord 8 ft. 1 in. (2.94 m.) at root, 4 ft. 1 in. (1.27 m.) at tip. Incidence 3° at root, 1° 40′ at tip. Two-spar stressed-skin light alloy construction. Slotted light alloy flaps. Mass-balanced light alloy ailerons. Total flap area 38.2 sq. ft. (3.55 m².). Total aileron area 50.2 sq. ft. (4.66 m.²). Gross wing area 400 sq. ft. (37.2 m.²).

FUSELAGE. — All - metal semi - monocoque stressed-skin structure.

TAIL UNIT.—Cantilever monoplane structure. Single-piece tailplane, two identical elevators, single fin and rudder, all of stressed-skin light-alloy construction. Areas : fin 29.48 sq. ft. (2.74 m.²), rudder 31.72 sq. ft. (2.94 m.²), tailplane 57.4 sq. ft. (5.34 m.²), elevators 44.7 sq. ft. (4.15 m.²). Tailplane span 18 ft. 9 in. (5.74 m.).

LANDING GEAR.—Retractable tricycle type. Pneumatic retraction. Electro Hydraulics oleo-pneumatic shock-absorbers. Palmer wheels and pneumatic brakes. Wheelbase 12 ft. (3.66 m.). Track 16 ft. 6 in. (5.05 m.).

POWER PLANT.—Two 540/560 h.p. Alvis Leonides Mk. 12701 nine-cylinder radial air-cooled engines. D.H. or Rotol three-blade constant-speed fully-feathering airscrews. Fuel in four interconnected crash-proof tanks, two in each wing. Inboard tanks 53 Imp. gallons (240 litres) each, outboard tanks 63 Imp. gallons (286 litres) each. Total fuel capacity 232 Imp. gallons (1,055 litres). Two oil tanks, one in each nacelle, 13 Imp. gallons (59 litres) each.

ACCOMMODATION.—Crew of two to four. Cabin may seat 6 to 10 passengers in backward-facing seats with baggage, or six stretcher cases, or may be equipped for



The Hunting Pembroke C. Mk. 1 (two 560 h.p. Alvis Leonides engines).



The Hunting President Light Transport (two 560 h.p. Alvis Leonides engines).

survey or photographic work or may be stripped for carriage of freight.

DIMENSIONS.—
Span 64 ft. 6 in. (19.6 m.).
Length 46 ft. 0 in. (14.0 m.).
Height 16 ft. 1 in. (4.9 m.).

WEIGHTS (Communications version).—
Weight empty (equipped) 9,178 lb. (4,160 kg.).
Fuel, oil and crew 2,299 lb. (1,044 kg.).
Eight passengers and baggage 1,732 lb. (786 kg.).
Weight loaded 13,500 lb. (6,125 kg.).

PERFORMANCE.—
Max. speed at 2,000 ft. (610 m.) 224 m.p.h. (360 km.h.).
Max. rich mixture cruising speed 209 m.p.h. (337 km.h.) at 5,000 ft. (1,525 m.).
Max. weak mixture cruising speed 199 m.p.h. (320 km.h.) at 10,000 ft. (3,050 m.).
Most economic cruising speed 155 m.p.h. (250 km.h.) at 8,000 ft. (2,440 m.).
Initial rate of climb 1,070 ft./min. 5.44 m./sec.).
Climb to 6,000 ft. (1,830 m.) 5.6 min.
Climb to 10,000 ft. (3,050 m.) 10.5 min.
Climb to 20,000 ft. (6,100 m.) 34.4 min.
Service ceiling 22,000 ft. (6,070 m.).
Range (still air) 1,150 miles (1,850 km.).
Take-off distance to 50 ft. (15.25 m.) at S/L. 2,520 ft. (678 m.).

THE HUNTING PRESIDENT.

The President is a development of the Pembroke for the civil market. Various refinements of design have enabled the maximum all-up weight to be increased to 13,500 lb. (6,130 kg.). The versatility of the Pembroke has been retained, thus enabling the President to be operated in a variety of rôles, amongst which are those of 6-passenger executive aircraft, 12-passenger feeder airliner, air survey and photography, freighter and air ambulance for 6 stretcher cases.

An order for three Presidents for Trabajos Aereos y Enlaces, of Bilbao, Spain, was announced in August, 1957.

TYPE.—Twin-engined General Purpose monoplane for Executive, Feeder-line, Charter and Freight-carrying duties.

WINGS, FUSELAGE, TAIL UNIT, LANDING GEAR AND POWER PLANT.—
As for Pembroke.

ACCOMMODATION.—Crew of two side-by-side with provision for dual controls. Entry door in bulkhead aft of cockpit. Main passenger cabin can seat 12 passengers (standard version) in forward or backward facing seats or 6 passengers in executive version. Entry at aft end of cabin on port side. Baggage compartment aft of cabin with access door immediately adjacent to passenger door. All interior equipment can be removed and entire cabin space used for freight-carrying. Dimensions of cabin: 20 ft. 1 in. (6.1 m.) long, 6 ft. 0 in. (1.8 m.) high, and 5 ft. 6 in. (1.68 m.) wide.

DIMENSIONS.
Same as Pembroke.

WEIGHTS (Standard 12-passenger version).—
Weight empty (equipped) 9,020 lb. (4,095 kg.).
Disposable load 4,471 lb. (2,030 kg.).
Weight loaded 13,500 lb. (6,125 kg.).

PERFORMANCE (at 13,500 lb.=6,125 kg.).—
Max. speed at 13,000 lb.=5,900 A.U.W. at 1,750 ft. (534 m.) 221 m.p.h. (356 km.h.).
Cruising speed at max. cont. power at 6,000 ft. (1,830 m.) 214 m.p.h. (345 km.h.).
Cruising speed using max. weak mixture power at 11,000 ft. (3,355 m.) 191 m.p.h. (308 km.h.).
Most econ. cruising speed for range at 8,000 ft. (2,440 m.) 152 m.p.h. (245 km.h.).
Stalling speed (power off, wheels and flaps down) 79.3 m.p.h. (128 km.h.).
Single-engine rate of climb at T.O. power, wheels up, flaps at take-off position, one propeller feathered 195 ft./min. (0.99 m./sec.).
Service ceiling 22,500 ft. (6,860 m.).
T.O. distance to 50 ft. (15.25 m.) from hard runway 2,520 ft. (768 m.).
T.O. distance to 50 ft. (15.25 m.) with critical engine failing at safety speed 3,750 ft. (1,145 m.).
Landing distance from 50 ft. (15.25 m.) in still air on hard runway 2,560 ft. (780 m.).
Max. still air range (with S.B.A.C. allowances) on internal fuel 900 miles (1,445 km.).
Max. range with underwing slipper tanks 1,518 miles (2,444 km.).

JACKAROO

JACKAROO AIRCRAFT LTD.

HEAD OFFICE AND WORKS: THRUXTON AERODROME, ANDOVER, HANTS.

Directors: Sq.-Ldr. J. E. Doran-Webb (Managing); Air Vice-Marshal N. C. Ogilvie-Forbes; Sq.-Ldr. M. F. Ogilvie-Forbes; R. Giddings; E. J. Heaton.

With the assistance of Mr. Eric Smith, who was responsible for the drawings and stress calculations, the Wiltshire School of Flying Ltd. produced a modification scheme which converts a standard de Havilland Tiger Moth biplane into a four-seat light aircraft at low cost.

Known as the Thruxton Jackaroo, the prototype aircraft modified to this design flew on March 2, 1957. A company named Jackaroo Aircraft Ltd. was formed to handle production, and owners of Tiger Moths are able to have their aircraft converted into Jackaroos at Thruxton, or can buy a conversion kit to do the work themselves.

The first production conversion by Jackaroo Aircraft flew on April 15, 1957. By the Spring of 1958, orders for about 100 aircraft and kits had been received and production was being increased to six aircraft a month.

THE THRUXTON JACKAROO.

The Jackaroo is essentially a Tiger Moth in which the centre-fuselage has been widened to accommodate four seats, in two pairs. The overall width of the fuselage is 36 in. (0.91 m.) compared with 23½ in. (0.60 m.) on the standard Tiger Moth.

Originally, the basic Jackaroo was



A line of five production Thruxton Jackaroo Light Cabin Biplanes.

designed as a dual-purpose aircraft, with interchangeable top deckings, so that it could be adapted into a single-seat agricultural aircraft with a hopper for 550 lb. (250 kg.) of dust for crop-spraying and top-dressing duties. This configuration is now made only to special order, because the standard four-seater has been found to be readily convertible for agricultural duties by removing the two starboard seats and inserting in their place either a dust hopper or spray-tank.

Normal welded steel-tube construction is used for the new centre-fuselage section, and an additional steel-tube bay is inserted in the fuselage forward of the centre-section wing struts, so that the engine is mounted further forward to offset the greater weight aft of the C.G.

The new structure picks up on existing fuselage fittings and the dual controls are maintained in tandem. Entry into the enclosed cabin is by forward-hinged doors.

No modifications are made to the wings, interplane struts, tail surfaces or rear fuselage. But the wider fuselage requires an extension of the centre-section by 12⅞ in. (0.32 m.) and this has the effect of increasing the wing span to 30 ft. 4½ in. (9.25 m.), the wing area to 246.7 sq. ft. (22.92 m.²) and the aspect ratio to 7.47.

Similarly, the landing gear track is increased to 6 ft. 3½ in. (1.92 m.). The wheels are fitted with simple mechanical disc brakes of Goodyear design, and a tailwheel will be fitted to production Jackaroos in place of the usual skid.

The standard power plant, built around a 130 h.p. de Havilland Gipsy Major I engine, is retained, the only modification being a simple revision of the cowling to provide additional cooling for tropical operation. A Fairey-Reed two-blade metal fixed-pitch airscrew can be fitted. Forward view from the cockpit has been improved by lowering the top of the decking by 4½ in. (11.4 cm.).

DIMENSIONS.—
Span 30 ft. 4½ in. (9.25 m.).
Length 25 ft. 9 in. (7.85 m.).
Height 8 ft. 10 in. (2.69 m.).

WEIGHTS.—
Weight empty 1,360 lb. (617 kg.).
Max. permissible loaded weight 2,181 lb. (989 kg.).

PERFORMANCE.—
Max. speed 104 m.p.h. (167 km.h.).
Economical cruising speed 85 m.p.h. (137 km.h.).
Stalling speed 37 m.p.h. (60 km.h.).
Rate of climb at S/L 600 ft./min. (183m./min.).
Take-off to 20 ft. (6.0 m.) in 6 m.p.h. (9.5 km.h.) wind 900 ft. (275 m.).
Max. endurance 2.75 hr.
Range 250 miles (400 km.).

M.L.

M.L. AVIATION COMPANY, LTD.

HEAD OFFICE: UNITED BUILDING, TRADING ESTATE, SLOUGH, BUCKINGHAMSHIRE.

WORKS AND AERODROME: WHITE WALTHAM, MAIDENHEAD, BERKSHIRE.

Directors: Sir Noel Mobbs, K.C.V.O., O.B.E. (Chairman); E. N. Mobbs (Managing Director): M. J. O. Lobelle, M.I. Mech.E., F.R.Ae.S. (Chief Designer); R. O. Mobbs, J.P.; D. L. Donne and M. R. Mobbs.

M.L. Aviation Co., Ltd., formerly R. Malcolm, Ltd., are designers and manufacturers of radio-controlled pilotless targets, high-speed target-towing apparatus, as well as various other kinds of aircraft equipment.

The company has produced the M.L. Utility Aircraft Mk. 1 inflatable-wing monoplane, for which the Ministry of Supply has placed a prototype contract.

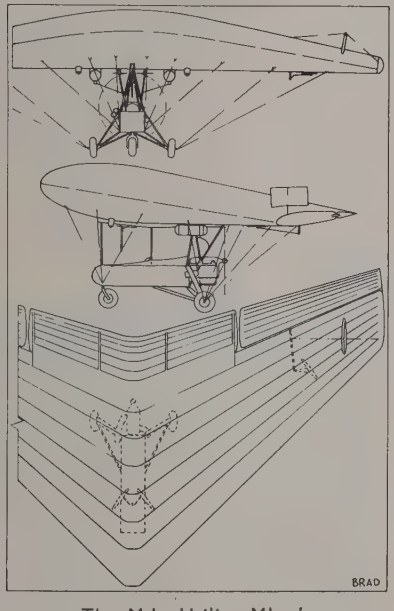


The M.L. Utility Mk. 1 Inflatable-wing Monoplane.

THE M.L. UTILITY MARK 1.

This aircraft is a development of the M.L. Utility, which was described and illustrated in the 1955-56 edition of this Annual, using the same type of unique inflatable wing. Designed by Mr. M. J. Lobelle, who was formerly chief designer of The Fairey Aviation Co., Ltd., it is intended for operation from small landing fields as a military reconnaissance and communications aircraft or civil utility aircraft. The aim was to provide an aircraft of low initial cost which is easy to maintain and occupies little space during storage and transportation.

The wing, which was developed originally by the Ministry of Supply Research and Development Establishment at Cardington, is entirely without rigid bracing and retains its form by the maintenance of pressure inside an inflated fabric envelope, to provide a stiff aerodynamic surface. The wing can be deflated after flight, rolled up into a bag and packed into the fuselage nacelle for transportation. Being of light construction, this nacelle is easily manhandled by a single person and can be towed behind a private car. It could be accommodated complete inside an average domestic garage.



The M.L. Utility Mk. 1.

The aircraft is controlled solely by means of elevons, which are operated by a cable and lever system connected to an inverted control column suspended from the top of the fuselage superstructure.

Correct differential air pressure of 0.5 lb./sq. in. (0.035 kg./cm.²) in the wing is maintained by a built-in electrically-driven pump and relief valves. Dismantling from the fuselage and deflation takes only a few minutes. Complete re-erection and inflation of the wing takes approximately thirty minutes.

By May, 1957 the prototype had completed 40 hours of flying.

TYPE.—Two-seat Inflatable wing monoplane.

WINGS.—Braced high wing monoplane of delta planform. Symmetrical wing section developed from N.A.C.A. 0024. Chord 17 ft. 6 in. (5.33 m.) at root, 5 ft. 9 in. (1.75 m.) at tip. No dihedral. Consists of rubber-proofed fabric envelope, with top and bottom surfaces connected by a number of porous fabric diaphragms which run spanwise and extend continuously from tip to tip. These diaphragms maintain the wing section by tension. The wing carries the fuselage by means of a series of straps and toggles secured to the undersurface. Flying wires attached to patches on the wing are secured to the fuselage and landing gear members. Inflated elevons extend for almost the entire span. No flaps. Total area of elevons 43 sq. ft. (4.0 m.²). Wing area 400 sq. ft. (37.16 m.²).

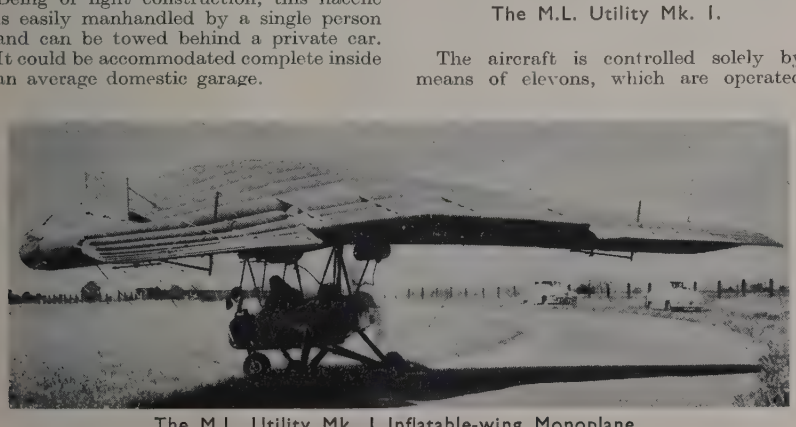
FUSELAGE.—Light car, mainly of wooden construction, with fabric covering.

TAIL UNIT.—None. But two small vertical stabilizers are fitted near wing-tips.

LANDING GEAR.—Fixed tricycle type. No shock-absorbers. Swivelling nose-wheel steered by rudder bar. Palmer 600-6.5 wheels. Palmer mechanical brakes. Parking brakes on rear wheels. Wheelbase 6 ft. 10 in. (2.08 m.). Wheel track 5 ft. 4 in. (1.62 m.).

POWER PLANT.—One 38.5 h.p. (de-rated) Walter Mikron III four-cylinder in-line inverted air-cooled engine mounted on rear of fuselage car and driving Airscrew & Jigwood Company two-blade fixed-pitch wooden airscrew. Methanol benzole-gasoline fuel in two tanks suspended below wing, with total capacity of 12 Imp. gallons (54.55 litres). Oil capacity 3 Imp. quarts (3.4 litres).

ACCOMMODATION.—Two seats in tandem in open car. Pilot in front and passenger



The M.L. Utility Mk. 1 Inflatable-wing Monoplane.

at rear. Instruments comprise airspeed indicator, altimeter, compass, wing pressure gauge, engine r.p.m. indicator and oil pressure gauge.

DIMENSIONS.—
Span 35 ft. (10.67 m.).
Length 23 ft. 3 in. (7.09 m.).
Height 10 ft. 6 in. (3.20 m.).

WEIGHTS.—
Weight empty 515 lb. (234 kg.).
Fuel 85 lb. (39 kg.).
Crew (2) 360 lb. (163 kg.).
Baggage 40 lb. (18 kg.).
Weight loaded 1,000 lb. (454 kg.).

PERFORMANCE.—
Max. speed (38.5 h.p.) 58 m.p.h. (93 km.h.).
Cruising speed (35 h.p.) 50 m.p.h. (80 km.h.).
Stalling speed 30 m.p.h. (48 km.h.).
Rate of climb at S/L. 690 ft./min. (210 m./min.).
Ceiling 5,000 ft. (1,525 m.).
Take-off distance 270 ft. (82 m.).
Take-off distance to 50 ft. (15.25 m.) 495 ft. (151 m.).
Endurance at cruising speed 2½ hours.

MILES



The Miles M.100 Mk. 1 Student Light Jet Trainer (Blackburn-Turbomeca Marboré IIA engine).

F. G. MILES, LIMITED.

HEAD OFFICE AND WORKS: SHOREHAM AIRPORT, SUSSEX.

Directors: F. G. Miles, F.R.Ae.S. (Chairman and Managing Director), Mrs. M.F.M. Miles, G. H. Miles, M.S.A.E. (Chief Designer), J. W. P. Angell and Mrs. O. M. Wadlow (Secretary).

F. G. Miles, Ltd. was formed in 1951 to design and build aircraft, to undertake aerodynamic and flight research and to conduct experimental work in structural plastics.

Mr. F. G. Miles has been associated with the aircraft industry since 1933 when Phillips & Powis Aircraft (Reading) Ltd. introduced the original Miles Hawk. Phillips & Powis Aircraft, Ltd. was formed as a public company in 1935 to take over the aircraft manufacturing business of Phillips & Powis Aircraft (Reading) Ltd. and in 1943 the company's name was changed to Miles Aircraft, Ltd.

Between 1933 and 1948, when Miles Aircraft Ltd. ceased to exist as an aircraft manufacturing company, a great variety of both civil and military aircraft types bearing the Miles name emanated from the Reading factory, the best-known being the Hawk Series, Falcon, Magister, Master, Martinet, Messenger, Gemini, Aerovan and Marathon, the last-mentioned being subsequently produced by Handley Page (Reading), Ltd.

The first products of F. G. Miles, Ltd. were conversions of earlier Miles designs.

The company is now developing as a private venture the M.100 Student basic training or communications monoplane, of which the prototype, powered by a Turbomeca Marboré IIA turbojet engine, made its first flight on May 14, 1957. Versions of five Marks of the M.100 to carry armament for ground support duties are under investigation.

In conjunction with the French Société des Avions Hurel-Dubois, Miles has built a development of the M.57 Aerovan, which is fitted with an Hurel high aspect ratio strutted wing and is known as the HDM.105. The prototype of this aircraft flew on March 31, 1957.

Larger aircraft on similar lines, known as the HDM.106 and HDM.107, have been projected and, in association with the Société des Avions Hurel-Dubois, Miles have formed a company known as H.D. et M. (Aviation) Ltd. to develop these types and to act as sales agents for the French-designed Hurel-Dubois aircraft.

Miles Structural Plastics Ltd. are continuing their production and development work in asbestos-phenolic materials, and in addition are expanding vigorously their glass-fibre reinforced plastic production. A new technique for making composite PVC glass-fibre components is already in production.

Miles Development Products Ltd., the precision machine and mechanical development company of the Group, is currently engaged in producing single-motored and twin-motored actuators, and the servo gearboxes for Miles Electronics Ltd. With the introduction of a number of new machine-tools the company is taking an increasingly important place in the Group.

Miles Electronics Ltd., having completed a simulator for flight-refuelling training, are currently engaged in manufacturing a fully operational simulator of the de Havilland Sea Vixen for the Royal Navy.

THE MILES M.100 STUDENT/CENTURION.

Designed and built as a private venture, the M.100 is a side-by-side two-seat light jet trainer which can be adapted easily for reconnaissance and ground support duties or as a four-seat fast communications aircraft.

The standard trainer version can be operated in the elementary training rôle with limited radio and navigational equipment, or in the basic training rôle with approximately 400 lb. (180 kg.) of additional equipment.

The prototype made its first flight on May 14, 1957 and five versions are offered for production :—

M.100 Mk. 1 Student. Similar to prototype, with one Blackburn-Turbomeca Marboré IIA turbojet (880 lb.=400 kg. s.t.).

M.100 Mk. 1A Student. Similar to Mk. 1 but with one Continental J69 turbojet (1,025 lb.=466 kg. s.t.).

M.100 Mk. 3 Centurion. Similar to Mk. 1, but with one Rolls-Royce R.B. 108 de-rated turbojet engine (1,400 lb.=637 kg. s.t.).

M.100 Mk. 4 Centurion. Similar to Mk. 3, but with two Turbomeca Gourdon turbojet engine with take-off output of 1,405 lb. (637 kg.) s.t.

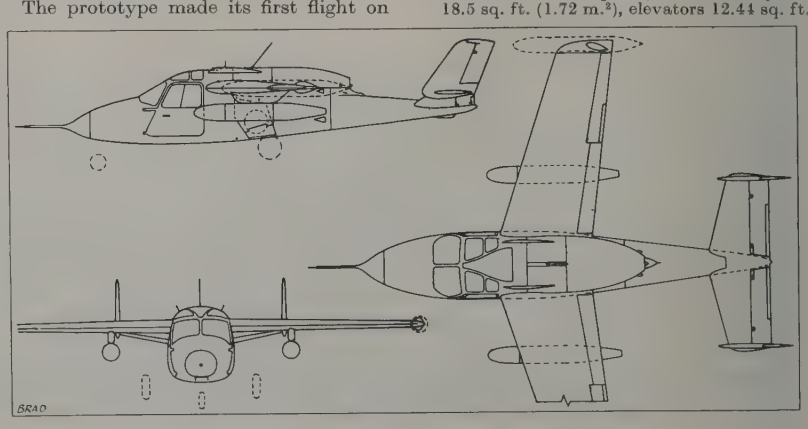
M.100 Mk. 5 Centurion. Similar to Mk. 3, but with two Turbomeca Arbizon turbojet engines, each with take-off output of 550 lb. (250 kg.) s.t.

TYPE.—General-purpose Light Jet Trainer.

WINGS.—Cantilever shoulder-wing monoplane. NACA 23015 wing section. Aspect ratio 5.6. Chord 6 ft. 6 in. (1.98 m.) at root, 4 ft. 6 in. (1.37 m.) at tip. No dihedral. Incidence 2½°. Sweepback 15°. All-metal single-spar structure. All-metal slotted ailerons and flaps. Total area of ailerons 13.61 sq. ft. (1.26 m.²). Total area of flaps 17 sq. ft. (1.58 m.²). Gross wing area 144 sq. ft. (13.40 m.²).

FUSELAGE.—All-metal structure. Front fuselage built around load-carrying keel. Rear fuselage semi-monocoque. Perforated dive-brakes in fuselage sides.

TAIL UNIT.—Cantilever monoplane type with twin fins and rudders. All-metal construction. Areas: fins 16.5 sq. ft. (1.53 m.²), rudders 8.5 sq. ft. (0.79 m.²), tailplane 18.5 sq. ft. (1.72 m.²), elevators 12.44 sq. ft.



The Miles M.100 Mk. 1 Student Jet Trainer.

(1.16 m.²). Tailplane span 11 ft. 8 in. (3.55 m.).

LANDING GEAR.—Retractable tricycle type. Dowty liquid spring shock-absorbers. Pneumatic retraction. Goodyear 600 × 6 wheels. Goodyear hydraulic single-disc brakes. Wheel track 7 ft. 0 in. (2.13 m.).

POWER PLANT.—One 880 lb. (400 kg.) s.t. Blackburn-Turbomeca Marboré IIA turbojet, or two 390 lb. (177 kg.) s.t. Blackburn-Turbomeca Palas 600 turbojets, or one de-rated Rolls-Royce R.B.108 turbojet, mounted in top of fuselage aft of cabin. Fuel in four tanks in wings with total capacity of 100 Imp. gallons (455 litres) and two wing-tip tanks with total capacity of 40 Imp. gallons (182 litres). Oil capacity 1.32 Imp. gallons (6 litres).

ACCOMMODATION.—Two seats side-by-side in enclosed cabin, with two large car-type doors which are jettisonable in an emergency. Provision for lightweight ejection seats, if required. Single or dual controls.

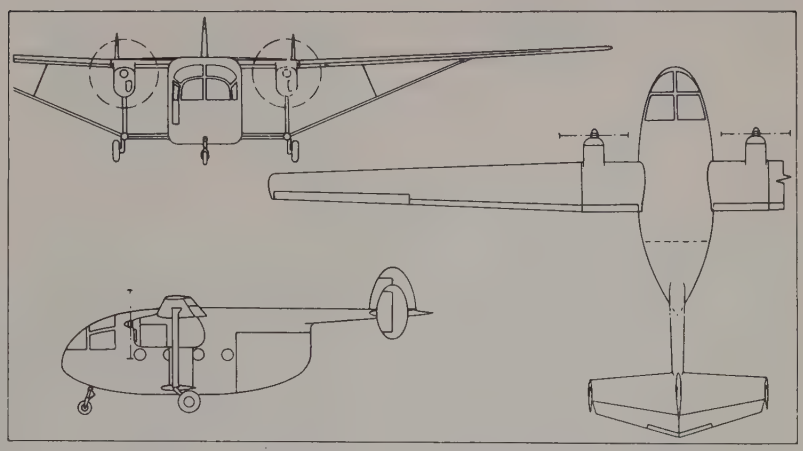
ARMAMENT.—For armament training two Browning 0.303 machine-guns (35 r.p.g.) can be fitted plus 4×Mk. 8 rockets with 60 lb. (27 kg.) warheads, or 6×Mk. 8 rockets with 25 lb. (11.3 kg.) warheads, or 8×25 lb. (11.3 kg.) practice bombs, or two Oerlikon pods each carrying 31×5 cm. rockets. All armaments are readily interchangeable and are carried in detachable underwing weapon pods.

DIMENSIONS.—
Span 29 ft. 2 in. (8.90 m.).
Length 30 ft. 9 in. (9.38 m.).
Height 6 ft. 3 in. (1.90 m.).

WEIGHTS AND LOADINGS (Mk. 1 and Mk. 2).—
Weight empty, equipped 2,300 lb. (1,043 kg.).
Weight loaded (elementary training) 3,100 lb. (1,406 kg.).
Weight loaded (basic training) 3,500 lb. (1,580 kg.).
Max. loaded weight 3,600 lb. (1,630 kg.).
Max. wing loading 26 lb./sq. ft. (127 kg./m.²).
Max. power loading 4.1 lb./lb. s.t. (4.1 kg./kg. s.t.).

WEIGHTS AND LOADINGS (Mk. 3).—
Weight empty 2,136 lb. (968 kg.).
Fixed and removable equipment 441 lb. (200 kg.).
Weight loaded 4,000 lb. (1,814 kg.).
Wing loading 27.8 lb./sq. ft. (135 kg./m.²).
Power loading 2.9 lb./lb. s.t. (2.9 kg./kg. s.t.).

PERFORMANCE (Mk. 1 at 3,100 lb. = 1,406 kg. A.U.W., estimated).—
Max. speed at S/L. 290 m.p.h. (467 km.h.).
Max. speed at 20,000 ft. (6,100 m.) 302 m.p.h. (486 km.h.).
Cruising speed at S/L. 254 m.p.h. (409 km.h.).



The Miles HDM.105 with the Hurel high aspect ratio wing.

Cruising speed at 20,000 ft. (6,100 m.) 268 m.p.h. (431 km.h.).
Landing speed 69 m.p.h. (111 km.h.).
Rate of climb at S/L. 2,050 ft./min. (625 m./min.).
Time to 10,000 ft. (3,050 m.) 5.7 min.
Time to 20,000 ft. (6,100 m.) 14 min.
Take-off distance to 50 ft. (15.25 m.) 1,740 ft. (530 m.).
Landing distance from 50 ft. (15.25 m.) 1,710 ft. (520 m.).
Range with 100 Imp. gallons (455 litres) fuel in still air at 215 m.p.h. (346 km.h.) at 20,000 ft. (6,100 m.), no allowance, 476 miles (767 km.).
Max. endurance, no allowances 2 hr. 35 min.

PERFORMANCE (Mk. 3, estimated).—
Max. speed at S/L. 337 m.p.h. (540 km.h.).
Max. speed at 20,000 ft. (6,100 m.) 351 m.p.h. (562 km.h.).
Cruising speed at S/L. 320 m.p.h. (512 km.h.).
Cruising speed at 20,000 ft. (6,100 m.) 328 m.p.h. (525 km.h.).
Rate of climb at S/L. 2,835 ft./min. (865 m./min.).
Time to 10,000 ft. (3,050 m.) 4.1 min.
Time to 20,000 ft. (6,100 m.) 10.3 min.
Take-off distance to 50 ft. (15.25 m.) 1,740 ft. (530 m.).
Landing distance from 50 ft. (15.25 m.) 2,190 ft. (670 m.).
Range with 140 Imp. gallons (637 litres) fuel in still air at 238 m.p.h. (382 km.h.) at 20,000 ft. (6,100 m.), no allowances, 630 miles (1,010 km.).
Max. endurance, no allowances 3 hr. 10 min.

PERFORMANCE (Mk. 4, estimated).—
Max. speed (max. cont. power) at 25,000 ft. (7,620 m.) 380 m.p.h. (612 km.h.).
Max. speed (emergency power) at 25,000 ft. (7,620 m.) 430 m.p.h. (692 km.h.).
Stalling speed (flaps down) at S/L 73 m.p.h. (117 km.h.).
Time to 10,000 ft. (3,050 m.) (emergency power) 3 min.
Time to 10,000 ft. (3,050 m.) (take-off power) 3.6 min.
Time to 10,000 ft. (3,050 m.) (max. cont. power) 4.3 min.
Time to 20,000 ft. (6,100 m.) (take-off power) 8.2 min.

PERFORMANCE (Mk. 5, estimated).—
Max. speed (max. cont. power) at 22,000 ft. (6,700 m.) 300 m.p.h. (483 km.h.).
Max. speed (take-off power) at 22,000 ft. (6,700 m.) 355 m.p.h. (571 km.h.).
Stalling speed (flaps down) at S/L 73 m.p.h. (117 km.h.).
Time to 10,000 ft. (3,050 m.) (take-off power) 5 min.
Time to 10,000 ft. (3,050 m.) (max. cont. power) 8.5 min..
Time to 20,000 ft. (6,100 m.) (take-off power) 12 min.



The Miles HDM.105 (two 155 h.p. Blackburn Cirrus Major III engines).

THE MILES HDM.105.

TYPE.—Twin-engined experimental monoplane.

WINGS.—High-wing strut-braced monoplane. NACA 63_4-420 wing section at root, NACA 63_1-412 wing section at tip. Aspect ratio 20.5. Chord 4 ft. 7 in. (1.39 m.) at root, 2 ft. 3½ in. (0.68 m.) at tip. Dihedral 5°. Incidence 2°. Aluminium-alloy single-spar structure. Frise type metal ailerons. Double-slotted metal and Durestos flaps. Total area of flaps 56.6 sq. ft. (5.26 m.²). Area of ailerons 22.8 sq. ft. (2.12 m.²). Gross wing area 277 sq. ft. (25.73 m.²).

FUSELAGE.—All-wood plywood-covered structure. All-metal tail-boom springing from top of rear fuselage carries tail-unit.

TAIL UNIT.—Cantilever monoplane type with three fins and rudders. All-wood plywood-covered structure. Areas: fins 23.71 sq. ft. (2.20 m.²), rudders 22.67 sq. ft. (2.11 m.²), tailplane 48.31 sq. ft. (4.49 m.²), elevators 24.0 sq. ft. (2.23 m.²). Span of tailplane 16 ft. 6 in. (5.0 m.).

LANDING GEAR.—Fixed nose-wheel type. Main wheels have articulated suspension units mounted directly to fuselage sides with Miles Airdraulic shock-absorbers. Steerable nose-wheel. Goodyear wheels size 24×7 and single-disc brakes. Wheelbase 9 ft. 6 in. (2.89 m.). Track 16 ft. 9 in. (5.10 m.).

POWER PLANT.—Two 155 h.p. Blackburn Cirrus Major III four-cylinder in-line inverted air-cooled engines. Fairey fixed-pitch metal airscrews. Oil capacity 2.5 Imp. gallons (11.4 litres) for each engine.

ACCOMMODATION.—Standard Aerovan accommodation provides for crew of two in flight compartment and an unobstructed freight cabin with rear loading doors beneath tail-boom. Can also be arranged to seat up to nine passengers, with a single crew member.

DIMENSIONS.—
Span 75 ft. 4 in. (22.97 m.).
Length 34 ft. 4 in. (10.40 m.).
Height 13 ft. 11 in. (4.25 m.).

WEIGHTS.—
Weight empty 3,219 lb. (1,461 kg.).
Design loaded weight 6,060 lb. (2,750 kg.).

PERFORMANCE (Estimated).—
Max. speed at S/L. 127 m.p.h. (204 km.h.).
Cruising speed at 3,000 ft. (915 m.) 116 m.p.h. (187 km.h.).
Initial rate of climb 657 ft./min. (200 m./min.).
Rate of climb at 1,500 ft. (460 m.) on one engine 57 ft./min. (17 m./min.).
Service ceiling 16,200 ft. (4,940 m.).
Min. T.O. run 852 ft. (260 m.).
Take-off distance to clear 50 ft. (15.25 m.) 1,932 ft. (589 m.).

THE MILES HDM.106 CARAVAN.

A developed version, known as the HDM.106, has been designed and could be built comparatively easily as it uses the same wing as the HDM.105. Its all-metal fuselage would be considerably larger than that of the HDM.105, with a length of 15 ft. (4.57 m.) a minimum width of 6 ft. 3 in. (1.91 m.) and a minimum height of 6 ft. (1.83 m.) giving a total volume of 563 cub. ft. (15.94 m.³). Powered by two 290 h.p. Lycoming GO-480 or 340 h.p. Lycoming GSO-480B engines, it would have correspondingly improved performance.

PHOENIX

PHOENIX AIRCRAFT LTD.

HEAD OFFICE: CRANLEIGH COMMON, CRANLEIGH, SURREY.

Directors: C. H. Latimer-Needham and A. W. J. G. Ord-Hume.

Phoenix Aircraft Ltd. was formed in 1958 to develop and produce ultra-light and light aircraft and engines, with particular emphasis on the manufacture of kits of parts for amateur assembly.

The company has begun by redesigning the pre-war Luton Minor single-seat light aeroplane, and is also building a new version of the two-seat Luton Major. Both of these types were developed in their original form by Luton Aircraft Ltd., which ceased to exist during the war when its premises were destroyed. Design rights of Luton Aircraft have been acquired by Phoenix Aircraft Ltd.



The Phoenix L.A.4a Minor (37 h.p. Aeronca J.A.P. engine).

THE PHOENIX L.A.4a MINOR.

The first L.A.4 Minor flew in 1937 and proved suitable for construction by amateurs and for operation by pilots of limited experience. Examples were built pre-war in England and other parts of the world.

Many improvements are incorporated in the new L.A.4a Minor, and the construction has been simplified. In particular, a fixed vertical tail fin is now fitted, together with a more robust landing gear similar to that of the Piper Cub.

Phoenix Aircraft supplies parts and components of the L.A.4a Minor to order and will offer complete kits of parts in due course. Plans are available through the Popular Flying Association.

TYPE.—Single-seat light monoplane.
WINGS.—Strut-braced parasol monoplane. Wing section R.A.F.32 (modified). Aspect ratio 5. Wooden two-spar structure in two halves, attached to the fuselage by tubular centre-section pylons and braced by parallel lift struts of streamline-section steel tubing. Wings removable for ground transport and storage. Leading-edge and tips plywood-covered, remainder fabric-covered. Plain ailerons of wood construction, fabric-covered. Wing area 125 sq. ft. (11.6 m.²).
FUSELAGE.—Rectangular all-wood structure. Sides and bottom plywood-covered. Curved decking aft of cockpit fabric covered. Fuel tank forms top decking forward of cockpit.
TAIL UNIT.—Cantilever monoplane type. All-wood structure, fabric-covered. Aerodynamically-balanced rudder.
LANDING GEAR.—Fixed tail-wheel type with divided main legs of tubular-steel construction. Rubber disc shock-absorbers. Wheel brakes optional. Fully-castoring tail-wheel.
POWER PLANT.—One 37 h.p. Aeronca J.A.P. two-cylinder horizontally-opposed air-cooled engine driving a two-blade fixed-pitch wooden airscrew. Airframe is designed to take alternative engines of up to 65 h.p. Fuel tank forward of cockpit, capacity 6.5 Imp. gallons (29.5 litres). Provision for additional tanks in wings.
ACCOMMODATION.—Single seat in open cockpit. Luggage space aft of seat.
DIMENSIONS.—
Span 25 ft. 0 in. (7.62 m.).
Length 20 ft. 9 in. (6.32 m.).
WEIGHTS.—
Weight empty 390 lb. (177 kg.).
Weight loaded 627 lb. (285 kg.).
Wing loading 5 lb./sq. ft. (24.4 kg./m.²).
Power loading 17 lb./h.p. (7.7 kg./h.p.).
PERFORMANCE.—
Max. speed 85 m.p.h. (137 km.h.).
Cruising speed 75 m.p.h. (121 km.h.).
Stalling speed 28 m.p.h. (45 km.h.).
Rate of climb at S/L 450 ft./min. (137 m./min.).
Take-off run 240 ft. (73 m.).
Landing run 120 ft. (36.5 m.).
Range 180 miles (290 km.).
Range with auxiliary wing tanks 400 miles (645 km.).

THE PHOENIX LUTON L.A.5 MAJOR.

The prototype Luton Major flew on March 12, 1939, but was destroyed during the war before further development could be carried out. Phoenix Aircraft is building the prototype of a new model suitable for amateur construction and this is expected to fly early in 1959. Plans and kits of parts will eventually be offered to amateur builders and it is hoped also to put the Major into limited production in completed form.

TYPE.—Two-seat Cabin monoplane.
WINGS.—Braced monoplane type of similar construction to those of the Luton Minor. Vee bracing struts. Wings fold back along sides of fuselage. Wing area 163 sq. ft. (15.14 m.²).
FUSELAGE.—Wooden structure except for centre-section area of welded steel-tube construction.
TAIL UNIT.—Cantilever monoplane type. Wooden structure.
LANDING GEAR.—Fixed tail-wheel type with divided main legs. Rubber disc shock-absorbers.
POWER PLANT (Prototype).—One 62 h.p. Walter Mikron Series 2 four-cylinder in-line air-cooled engine.
ACCOMMODATION.—Enclosed cabin seating two persons in tandem, with dual controls. Door on starboard side.
DIMENSIONS.—
Span 35 ft. 2 in. (10.72 m.).
Length 23 ft. 9 in. (7.24 m.).
WEIGHTS.—
Weight empty 600 lb. (272 kg.).
Max. loaded weight 1,030 lb. (467 kg.).
PERFORMANCE.—
Max. speed 105 m.p.h. (169 km.h.).
Cruising speed 95 m.p.h. (153 km.h.).
Stalling speed 35 m.p.h. (56 km.h.).
Rate of climb at S/L. 700 ft./min. (213 m./min.).
Range 300 miles (483 km.).

ROLLASON

ROLLASON AIRCRAFT AND ENGINES LTD.

HEAD OFFICE AND WORKS: CROYDON AIRPORT, CROYDON, SURREY.

Directors: Norman Jones, Alan Sproxton, Mrs. W. M. Rollason.

Secretary: W. V. Fitzmaurice.

Well-known for many years as an aircraft sales and service organization, this company entered the manufacturing field in 1957. It is building under licence the French Druine Turbulent ultra-light monoplane, for which it has also undertaken conversion of Ardem 4CO2 engines. The first Rollason-built Turbulent flew on January 1, 1958.

Rollason is also manufacturing Turbulent components to assist amateur constructors of this aircraft.



The first Rollason-built Turbulent Light Monoplane.

THE ROLLASON (DRUINE) TURBULENT.

In general, the Rollason-built Turbulent is similar to the standard Druine design. Main differences are that it has wheels of slightly-greater size (12 in. = 0.30 m.) and a tail-skid instead of a tail-wheel. The landing gear is made to a different standard, and no brakes are fitted.

The Rollason-built Turbulent is powered by a 30.7 h.p. Ardem four-cylinder horizontally-opposed air-cooled engine, the conversion of which from a standard motor car engine is undertaken by Rollason.

WEIGHTS.—
Weight empty 350 lb. (159 kg.).
Weight loaded 607 lb. (275 kg.).
DIMENSIONS.
Span 21 ft. 5 in. (6.53 m.).
Length 17 ft. 4½ in. (5.30 m.).
Height 4 ft. 5 in. (1.35 m.).
PERFORMANCE.—
Max. speed 87 m.p.h. (140 km.h.).
Cruising speed 75 m.p.h. (121 km.h.).
Landing speed 28 m.p.h. (45 km.h.).
Rate of climb at S/L 492 ft./min. (150 m./min.).
Take-off run 435 ft. (133 m.).
Endurance 2½ hours.

SAUNDERS-ROE

SAUNDERS-ROE, LIMITED.

HEAD OFFICE: OSBORNE, EAST COWES, ISLE OF WIGHT.

WORKS: EAST COWES, ISLE OF WIGHT, AND AT SOUTHAMPTON AIRPORT, EASTLEIGH, HANTS.

HELICOPTER DIVISION: SOUTHAMPTON AIRPORT, EASTLEIGH, HANTS.

Directors: The Hon. H. N. Morgan-Grenville, O.B.E. (Chairman), Sir Arthur Gouge, B.Sc., F.R.Ae.S., M.I.Mech.E. (Vice-Chairman), Captain E. D. Clarke, C.B.E., M.C. (Managing Director), W. Browning, F.R.Ae.S., A.M.I.Mech.E., M.I.P.E. (General Manager), F. E. N. St. Barbe and P. D. Irons, B.Com., A.C.A., F.C.W.A. (Secretary).

Chief Designer: M. J. Brennan, B.Sc., M.I.Mech.E., F.R.Ae.S.

Chief Designer, Helicopter Division: T. L. Ciastula, Dipl.-Ing., A.M.I.Mech.E., A.F.R.Ae.S.

Post-war activities of Saunders-Roe, Ltd. have included development of the S-R.A1 experimental jet fighter flying-boat and the 345,000 lb. Princess flying-boat, powered by ten Proteus turboprop engines.

The first Princess flew on August 22, 1952, and completed extensive and successful flight trials before the decision was taken in 1954 to suspend further development until more suitable engines than the Proteus 600 Series became available. Together with the airframes of the second and third aircraft, it is now Cocooned, pending a decision as to its future.

A full description of the Princess has appeared in earlier editions of this work.

In 1956 it was announced that the company was engaged in the development and construction of a mixed-unit (jet/rocket) interceptor under the designation S-R.53. Two prototypes were built.

From the S-R.53 was evolved the higher-powered S-R.177 which was designed to meet a naval requirement. The construction of a number of prototypes was well advanced, when, in December, 1957, the contract was cancelled in accordance with the policy outlined in the British Government's White Paper on Defence.

In 1956 de Havilland Holdings, Limited acquired an interest in Saunders-Roe, Limited.



The Saunders-Roe P.531 Helicopter (Blackburn-Turbomeca Turmo 600 engine).

THE SAUNDERS-ROE P.531.

The Saunders-Roe P.531 is a compact turbine-powered general-purpose helicopter which uses a number of rotor and transmission system components from the Skeeter. Project work on the design was started in November, 1957. On January 1, 1958, it was decided to proceed with the design and construction of several prototypes, and the first of these began its ground running only six months later on June 19. It made its first flight on July 20, 1958.

The P.531 is intended for a variety of military and civil duties, including liaison, light freighting, casualty evacuation, air/sea rescue, reconnaissance, training in turbine techniques and as a weapon carrier. In its passenger-carrying form it has two seats in front and a rear bench-type seat for three persons. The rear seat folds flat against the bulkhead, if required, leaving a clear floor space for freight. In the ambulance rôle, this space is utilised for carrying two standard service stretchers, with a medical assistant by the side of the pilot in the front seat, which is reversible. A lightweight Lucas air-operated hoist can be fitted for rescue operations. External loads can be carried in slings or a cargo net under the fuselage. Full blind-flying equipment and instruments are available for training.

Use of a 425 h.p. Blackburn-Turbomeca Turmo 600 free-turbine engine eliminates the need for a clutch in the transmission and enables the P.531 to be operated on a variety of fuels including low octane gasoline, kerosene and light diesel oils. The engine, transmission and rotor systems are mounted above the main structure to offer maximum accessibility, and all controls and electrics are reached through large hinged panels running the length of the forward fuselage sides. The nose is hinged to give access to the instrument panel, rudder controls and radio.

A constant-speed rotor/turbine control system, with pre-select facility, simplifies handling and ensures maximum performance in all conditions of all-up weight, altitude and temperature.

DIMENSIONS.—
Main rotor diameter 32 ft. 6 in. (9.90 m.).
Length (blades folded) 29 ft. (8.84 m.).
Width (blades folded) 8 ft. 6 in. (2.59 m.).
Height 9 ft. 6 in. (2.90 m.).
WEIGHTS.—
Weight empty, equipped 2,092 lb. (949 kg.).
Weight loaded 3,800 lb. (1,724 kg.).
PERFORMANCE.—
Max. speed 121 m.p.h. (195 km.h.).
Cruising speed 115 m.p.h. (185 km.h.).
Normal range 242 miles (390 km.).
Normal endurance 3.3 hours
Max. range with long-range tank 322 miles (520 km.).
Max. endurance with long-range tank 5.2 hr.



The Saunders-Roe Skeeter equipped as an Ambulance.

THE SAUNDERS-ROE SKEETER.

The Skeeter was originally designed and built by the Cierva Autogiro Company, Ltd. before that company was taken over by Saunders-Roe in 1951. Saunders-Roe have continued its development.

The Series 6 (Mks. 10 and 11) and 7 (Mks. 12 and 13) have been adopted for service in the Royal Air Force, the British Army, and the Army and Navy of the Federal German Republic. The military versions have the following official designations:—

Skeeter A.O.P. Mk. 10. Air observation post, ordered for service with the Army Air Corps.

Skeeter T. Mk. 11. Training version for R.A.F.

Skeeter A.O.P. Mk. 12. Similar to Mk. 10 but powered by the 215 h.p. D.H. Gipsy Major 215 engine. In production for British Army.

Skeeter T. Mk. 13. Similar to T. Mk. 11 but with 215 h.p. D.H. Gipsy Major 215 engine. In production for R.A.F.

Skeeter Mk. 51. Similar to Mk. 12. Standard model for Navy of German Federal Republic.

A civil version of the Mk. 12 is under development as the Skeeter 8, of which three are being built for C. of A. trials.

TYPE.—Two-seat light helicopter.

ROTOR SYSTEM.—Three-blade main rotor, fully-articulated hub with drag and flapping hinges. Rotor blades have steel tubular spars, wood ribs and wood and fabric skin. One two-blade anti-torque and steering rotor with solid wood blades. Main rotor blade area 11.95 sq. ft. (1.11 m.²). Main rotor disc area 804 sq. ft. (74.69 m.²). Anti-torque rotor disc area 28.3 sq. ft. (2.63 m.²).

FUSELAGE.—Steel tubular centre-section, sheet metal fabricated front fuselage, sheet metal monocoque tail boom.

LANDING GEAR.—Tricycle type. Saunders-Roe oleo-spring shock-absorbers. Palmer wheels and tyres. Wheelbase 5 ft. 1 in. (1.55 m.). Track 7 ft. (2.13 m.).

POWER PLANT.—One 200 h.p. (Series 6) or 215 h.p. (Series 7) de Havilland Gipsy Major four-cylinder inverted air-cooled engine mounted athwartships in fuselage centre-section immediately aft of cabin fireproof bulkhead. Transmission for main rotor through spur reduction gear to intermediate shaft driving final bevel. Tail rotor driven off same intermediate shaft through free-wheel and manually-operated clutch. Main rotor/engine r.p.m. ratio 1 : 8.32. Anti-torque rotor/engine r.p.m. ratio 1 : 1.88. Fuel tank in fuselage forward of fireproof bulkhead. Fuel capacity 23 Imp. gallons (105 litres). Oil tank capacity 3 Imp. gallons (13.5 litres).

ACCOMMODATION.—Cabin seats two side-by-side. Entrance door on each side. Observer's seat reversible in military version. Provision for two stretchers, mounted externally on sides of cabin.

DIMENSIONS.—
- Main rotor diameter 32 ft. (9.76 m.).
- Overall length (blades folded) 28 ft. 5 in. (8.66 m.).
- Length of fuselage 26 ft. 6 in. (8.10 m.).
- Overall width (blades folded) 7 ft. 4½ in. (2.25 m.).
- Height over main rotor head 7 ft. 6 in. (2.29 m.).
- Tail rotor diameter 6 ft. (1.83 m.).

WEIGHTS (Series 6).—
- Tare weight 1,626 lb. (738 kg.).
- Disposable load 574 lb. (260 kg.).
- Normal all-up weight 2,150 lb. (980 kg.).
- Max. all-up weight 2,200 lb. (1,000 kg.).

WEIGHTS (Series 7).—
- Weight loaded (normal) 2,200 lb. (1,000 kg.).
- Weight loaded (supercharged engine) 2,250 lb. (1,020 kg.).



The Saunders-Roe Skeeter Mk. 51 for the German Navy.

PERFORMANCE (Series 6—I.S.A. conditions at normal A.U.W.).—
- Max forward speed at S/L 101 m.p.h. (162 km.h.).
- Max. cruising speed at S/L 99 m.p.h. (158 km.h.).
- Vertical rate of climb at S/L. 230 ft./min. (70 m./min.).
- Max. rate of climb 1,020 ft./min. (310 m./min.).
- Hovering ceiling (free air) 1,100 ft. (335.5 m.).
- Min. rate of descent (engine off) 1,350 ft./min. (412 m./min.).
- Service ceiling 11,700 ft. (3,560 m.).
- Absolute ceiling 12,900 ft. (3,930 m.).
- Max. endurance at 52 m.p.h. (83 km.h.) at S/L. 3.3 hours.
- Max. range at 86 m.p.h. (136 km.h.) at S/L. 238 miles (382 km.).

PERFORMANCE (Series 7, normal).—
- Max. speed 104 m.p.h. (167 km.h.).
- Max. cruising speed 101 m.p.h. (163 km.h.).
- Vertical rate of climb at S/L 425 ft./min. (130 m./min.).
- Max. rate of climb with forward speed of 52 m.p.h. (84 km.h.). 1,150 ft./min. (350 m./min.).
- Service ceiling 12,800 ft. (3,900 m.).
- Hovering ceiling in ground effect 5,500 ft. 11,680 m.).
- Hovering ceiling out of ground effect 2,500 ft. (762 m.).
- Max. range 213 miles (342 km.).
- Max. endurance 3 hours.

PERFORMANCE (Series 7, supercharged engine).—
- Max. speed 102.5 m.p.h. (165 km.h.).
- Max. cruising speed 100 m.p.h. (161 km.h.).
- Vertical rate of climb at S/L 425 ft./min. (130 m./min.).
- Max. rate of climb with forward speed of 52 m.p.h. (84 km.h.) 1,150 ft./min. (350 m./min.).
- Service ceiling 16,700 ft. (5,100 m.).
- Hovering ceiling in ground effect 11,100 ft. (3,385 m.).
- Hovering ceiling out of ground effect 8,100 ft. (2,445 m.).
- Max. range 190 miles (305 km.).
- Max. endurance 2.7 hours.

In conjunction with D. Napier & Son, Ltd., Saunders-Roe have applied a rocket booster system to the Skeeter to provide additional emergency power for short periods.

The booster system provides thrust at the rotor tips so that no additional torque is imposed on the existing transmission system. The rotor speed is not increased, the power being absorbed in greater lift on the rotor blades.

The fuel, high-test peroxide, is stored in a tank mounted above the rotor hub and is pumped to the Napier rocket motors by the centrifugal action of the rotor blades. On entering the rocket motors the liquid peroxide is decomposed into superheated steam and oxygen by a catalyst. The generated gases then pass to a nozzle at the tip of each rotor blade which causes the gases to be ejected at high velocity to provide thrust reaction.

With rocket booster the Skeeter Mk. 6 at normal A.U.W. of 2,150 lb. (980 kg.) has the following performance :—
- Vertical rate of climb at S/L. 1,400 ft./min. (427 m./min.).
- Hovering ceiling (free air) 8,500 ft. (2,592 m.).
- Rate of climb at S/L. 1,800 ft./min. (550 m./min.).
- Min. rate of descent (piston engine off) 650 ft./min. (198 m./min.).
- Max. forward speed at S/L. 115 m.p.h. (184 km.h.).



The Saunders-Roe Skeeter with Napier blade-tip rocket booster system.

SCOTTISH AVIATION

SCOTTISH AVIATION, LTD.

HEAD OFFICE AND WORKS: PRESTWICK AIRPORT, AYRSHIRE.

LONDON OFFICE: 25, COCKSPUR ST., S.W.1.

Directors: The Duke of Hamilton, P.C., G.C.V.O., A.F.C., F.R.G.S. (Chairman), Bernard Boxall, B.Sc., A.C.G.I., M.I.Mech.E., M.I.Prod.E. (Deputy Chairman), T. D. M. Robertson (General Manager), R. McIntyre, F.R.Ae.S. (Chief Engineer), Sir Jackson Millar and H. W. Fulton.

Scottish Aviation Ltd. was formed in 1935 to provide opportunities for employment in the various branches of aviation in Scotland. In doing so, the company has developed the International Airport at Prestwick and on it has established an aircraft design and manufacturing industry.

The company's five-seat Prestwick Pioneer first flew in 1950 and its use by the Royal Air Force, particularly in the jungle territory of Malaya, has demonstrated its possibilities for transport support in hitherto inaccessible regions.

The Pioneer has been followed by a twin-engined version carrying a crew of two and sixteen passengers and known as the Twin Pioneer. This aircraft received a full normal category Certificate of Airworthiness on November 16, 1956, and is in quantity production in both civil and military versions.

THE TWIN PIONEER.

The Twin Pioneer is a twin-engined light general purpose aircraft, suitable for civil or military use. The prototype first flew on June 25, 1955, and the first production Twin Pioneer flew on April 28, 1956. Tropical trials have since been carried out and the Twin Pioneer is cleared for operation in temperatures up to I.S.A.+25°C.

Twin Pioneers were operating in Australia, Austria, Borneo, Dutch New Guinea, Iraq and Iran by the Spring of 1958, and had been ordered also for use in Aden, Ceylon, French Equatorial Africa, Kuwait, Malaya, Nigeria, the Philippines and South Africa. A military version is in quantity production for the Royal Air Force as the Twin Pioneer C.C. Mk. 1.

Standard power plant of the Twin Pioneer is the Alvis Leonides piston-engine; but Philippine Air Lines have ordered five aircraft fitted with Pratt & Whitney R-1340 engines and the first of these flew for the first time on August 31, 1958.

In its civil form, the Twin Pioneer normally carries 16 passengers or equivalent freight, but it can be specially equipped for a variety of other duties. Its stability and exceptional control at low speeds suit it particularly for photographic and geophysical survey operations.

The photographic survey version carries a crew of two and up to three camera operators. The floor-mounted camera installations will accommodate the majority of modern vertical aerial survey cameras. The camera hatches are provided with sliding doors, operated from the cabin, which seal the hatches externally. A camera floor hatch is also supplied which covers completely the camera aperture on removal of the camera installation, thus providing an unobstructed cabin floor.

The geophysical survey Twin Pioneer carries a crew of two and up to three survey equipment operators. In this rôle, the aircraft is fitted with survey equipment and special aids such as E.M.U. transmitter and receiver coils, magnetometer, scintillometer, radio altimeter, Aeropath strip camera and Edin recorder. Where necessary, non-magnetic control cables and tie rods are installed.

The Twin Pioneer can be equipped as an executive transport, or as an ambulance carrying six stretcher cases and five seated casualties. In its military form, it can also be fitted with racks for dropping supplies, light bombs or other stores.

The following data refer to the standard version with Leonides engines.

TYPE.—Twin-engined Transport designed for operation from small landing fields.

WINGS.—High-wing braced monoplane. NACA 4415 wing section. Aspect ratio 8.74. Chord, root 12 ft. 8½ in. (3.87 m.), tip 7 ft. 11 in. (2.41 m.). Dihedral 1° 58′ on centre section, 3° on outer wings. Incidence 4°. Two-spar light alloy stressed skin structure. Fowler type light alloy flaps and hydraulically-operated slats on leading edge. Slotted ailerons have light alloy frames and fluted metal skin. Total area of flaps 104.4 sq. ft. (9.70 m.²). Total aileron area 47.6 sq. ft. (4.42 m.²). Gross wing area 670 sq. ft. (62.24 m.²).

FUSELAGE.—Light alloy stressed-skin semi-monocoque structure.

TAIL UNIT.—Cantilever monoplane type. Light alloy stressed-skin structure with fluted skin on control surfaces to give improved strength/weight ratio. Port and starboard elevators interchangeable. Areas: fins 106.6 sq. ft. (9.90 m.²), rudders 60.7 sq. ft. (5.64 m.²), tailplane 115.3 sq. ft. (10.71 m.²), elevator 51.9 sq. ft. (4.82 m.²). Tailplane span: 25 ft. 7½ in. (8.03 m.).

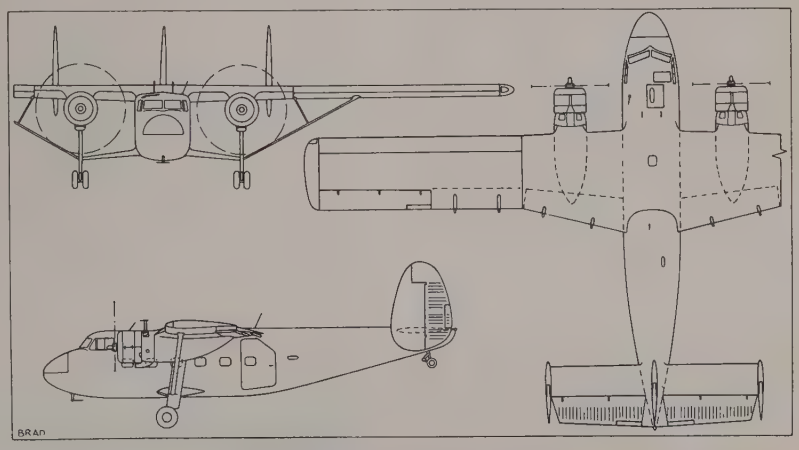
LANDING GEAR.—Fixed tail-wheel type. Electro Hydraulics, Ltd. oleo-pneumatic shock-absorber struts. Twin wheels on main units. Dunlop wheels with three-cylinder single-plate caliper hydraulic brakes. Track 18 ft. 6 in. (5.63 m.). Wheelbase 28 ft. (8.53 m.).

POWER PLANT.—Two 520/540 h.p. Alvis Leonides 514/8 radial air-cooled engines, driving D.H. PD 205/323/1 3-blade feathering constant-speed airscrews; or two 600 h.p. Pratt & Whitney R-1340 radial air-cooled engines. Two 90 Imp. gallon (409 litres) and two 33.5 Imp. gallon (152.25 litres) tanks in wings. Total fuel capacity (civil 247 Imp. gallons (1,122.5 litres). Military version has normal tankage of 371 Imp. gallons (1,687 litres) in wings, and can also carry one or two 100 Imp. gallon (455 litre) ferry tanks in cabin. One 9 Imp. gallon (41 litre) oil tank in each engine nacelle.

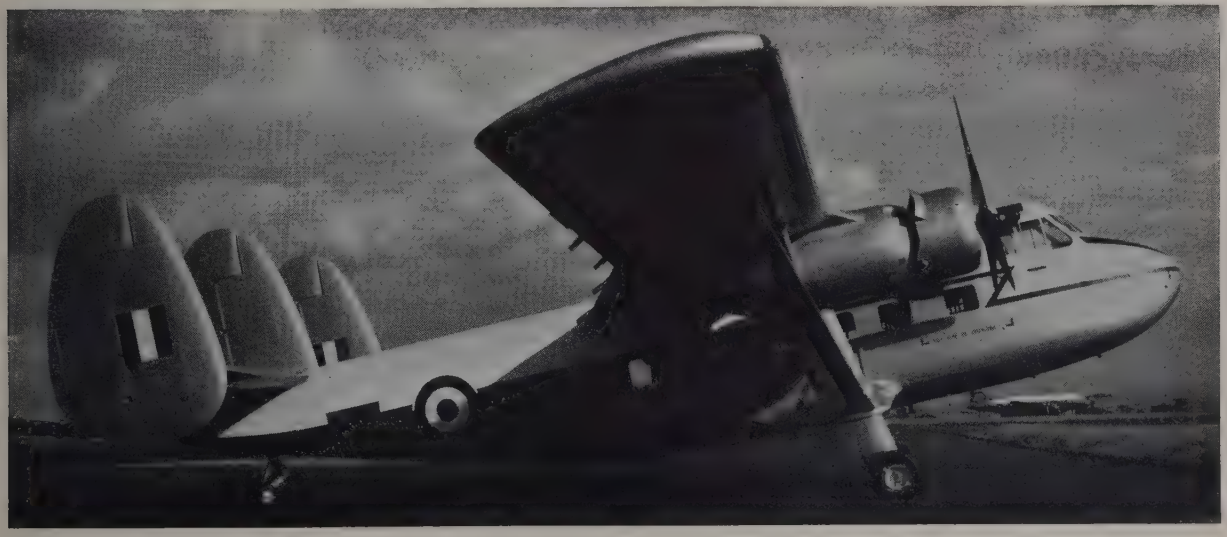
ACCOMMODATION (Civil).—Pilot and co-pilot or radio-operator and sixteen passengers. Large freight loading and passenger entry door on port side. Forward luggage com-



The Scottish Aviation Twin Pioneer in the colours of Borneo Airways.



The Scottish Aviation Twin Pioneer.



The Scottish Aviation Twin Pioneer C.C. Mk. 1 (two 540 h.p. Alvis Leonides engines).

partment at front of cabin in Leonides-powered version, aft of cabin in version with R-1340 engines.

ACCOMMODATION (Military).—Crew of two and 16 passengers, 12 fully-equipped troops or 10 paratroops on folding canvas seats along sides of cabin. Equipped also for ambulance rôle with 12 litters, supply-dropping rôle with up to 3,400 lb. (1,540 kg.) of cargo, or bombing rôle with up to 2,000 lb. (907 kg.) of H.E. or anti-personnel bombs under sponsons. Bomb-aimer's prone position is in main cabin.

DIMENSIONS.—
Span 76 ft. 6 in. (23.33 m.).
Length 45 ft. 3 in. (13.80 m.).
Height 12 ft. 3 in. (3.70 m.).

WEIGHTS AND LOADING.—
Weight empty 9,600 lb. (4,354 kg.).
Disposable load 4,100 lb. (1,860 kg.).
Weight loaded 14,000 lb. (6,350 kg.).
Wing loading 20.90 lb./sq. ft. (102 kg./m.²).

PERFORMANCE (Civil).—
Max. speed at 1,450 ft. (440 m.) 165 m.p.h. (265 km.h.).
Max. continuous cruising speed at 3,400 ft. (1,035 m.) 163 m.p.h. (262 km.h.).
Stalling speed 60 m.p.h. (96 km.h.).
Service ceiling 17,000 ft. (5,210 m.).
Take-off distance to 50 ft. (15.25 m.) 1,120 ft. (340 m.).
Landing distance from 50 ft. (15.25 m.) 1,170 ft. (357 m.).
Range at cruising speed of 119 m.p.h. (191 km.h.) at 5,000 ft. (1,525 m.) 916 miles (1,475 km.).

THE PRESTWICK PIONEER.

The prototype of the Leonides-powered Prestwick Pioneer flew on May 5, 1950, and the first production model on June 25, 1953. This version is in service with the Royal Air Force as the Pioneer C.C. Mk. 1.

TYPE. Five-seat light Transport, designed for operation from small landing fields.

WINGS.—High-wing strut-braced monoplane. Constant chord wing of NACA 4415 section fitted with hydraulically-operated full-span slats and 57.5% span Fowler and split flaps. For take-off, leading-edge slat is open and Fowler flap setting 20°. For landing, the Fowler flap lowers to 30°. Aspect ratio 6.38. Chord 7 ft. 11 in. (2.41 m.). The dihedral angle is 1° and incidence 4°. Wings of aluminium-alloy all-metal, two-spar stressed-skin construction. Wings braced to fuselage by single strut on each side. Fowler flap and slat run in tracks of extruded I-section light alloy and are operated by a system of cables from single jack located in port wing. Slotted ailerons are of aluminium-alloy construction with fabric covering. Aluminium-alloy flaps and slats are interchangeable port and starboard. Aileron area 30 sq. ft. (2.79 m.²). Fowler flap area 67.7 sq. ft. (6.29 m.²). Gross wing area 390 sq. ft. (36.2 m.²).

FUSELAGE.—Mainly aluminium-alloy semi-monocoque stressed-skin construction of basically oval cross-section, but with high-tensile steel-tube structure in region of wing centre-section.

TAIL UNIT.—Cantilever monoplane type, but with short additional support struts to front spar of tailplane. Construction of tailplane and fin is similar to that of wing. Rudder and elevators are metal with fabric covering, port and starboard elevators being interchangeable. The tail-plane is electrically actuated, its incidence being adjustable in flight over a range from +4° to —9°. Areas: fin 16.32 sq. ft. (1.52 m.²), rudder 14.58 sq. ft. (1.35 m.²), elevators 38.2 sq. ft. (3.55 m.²), tailplane 46.3 sq. ft. (4.3 m.²). Tailplane span 18 ft. 8 in. (5.69 m.).

LANDING GEAR.—Fixed tail-wheel type. Oleo-pneumatic shock-absorber struts made by J. McDonald & Co. Goodyear wheels and three-cylinder, single-plate, caliper hydraulic wheel-brakes. Track 9 ft. 6 in. (2.9 m.). Wheelbase 21 ft. 7 in. (6.58 m.).

POWER PLANT.—One 520/540 h.p. Alvis Leonides 502/7 radial air-cooled engine, supplied as a complete power-plant unit. D.H. Type D.183/313/1 three-blade feathering constant-speed airscrew. Fuel in four tanks, two in each wing, with a total capacity of 128 Imp. gallons (582 litres). Oil capacity 4.5 Imp. gallons (20.5 litres).



The Pioneer C.C. Mk. 1, the R.A.F. version of the Prestwick Pioneer.

ACCOMMODATION.—Enclosed cabin seating five in a one-two-two arrangement with the pilot's seat forward on the centre line. The back of the pilot's seat hinges rearwards to facilitate entry and exit. Seats and harness stressed to withstand a deceleration of 25 g. All seats are readily removable and the cabin can be arranged to carry one stretcher and attendant. A stretcher hatch is provided in the port side of the fuselage to facilitate casualty loading.

DIMENSIONS.—
Span 49 ft. 9 in. (15.17 m.).
Length 34 ft. 4¾ in. (10.49 m.).
Height (tail down) 11 ft. 4⅝ in. (3.47 m.).

WEIGHTS AND LOADINGS.—
Weight empty 4,230 lb. (1,920 kg.).
Disposable load 1,570 lb. (713 kg.).
Weight loaded 5,800 lb. (2,630 kg.).
Wing loading at take-off 14.9 lb./sq. ft. (72.7 kg./m.²).
Power loading at take-off 10.38 lb./h.p. (4.7 kg./h.p.).

PERFORMANCE.—
Max. speed at 1,500 ft. (460 m.) 145 m.p.h. (234 km.h.).
Max. continuous cruising speed at 6,700 ft. (2,040 m.) 142 m.p.h. (228 km.h.).
Stalling speed 43 m.p.h. (69 km.h.).
Service ceiling 15,850 ft. (4,830 m.).
Range at 115 m.p.h. (185 km.h.) at 5,000 ft. (1,525 m.) 805 miles (1,297 km.).
Take-off distance to 50 ft. (15.2 m.) 800 ft. (245 m.).
Landing distance from 50 ft. (15.2 m.) 900 ft. (275 m.).

SHORT

SHORT BROTHERS & HARLAND, LTD.

HEAD OFFICE, WORKS AND AERODROME: QUEEN'S ISLAND, BELFAST, N. IRELAND.

OTHER FACTORIES: NEWTOWNARDS (2), CASTLEREAGH, BELFAST (2), AND ROCHESTER.

LONDON OFFICE: 17, GROSVENOR STREET, W.1.

Honorary Life President: H. O. Short, F.R.Ae.S.

Directors: Rear-Admiral Sir Matthew S. Slattery, C.B., D.Sc., F.R.Ae.S. (Chairman and Managing Director); J. S. Baillie; Sir James H. Barnes, K.C.B., K.B.E., M.A.; Sir Sam H. Brown; H. G. Conway, M.A., M.I.Mech.E., F.R.Ae.S. (Deputy Managing Director); R. E. Harvey (Deputy Managing Director); D. Keith-Lucas, M.A., M.I.Mech.E., F.R.Ae.S. (Technical Director); Sir Frederick E. Rebbeck, K.B.E., D.Sc., D.L., J.P.; Sir Reginald Verdon Smith, M.A., B.C.I., J.P.; C. F. Uwins, O.B.E., A.F.C., F.R.Ae.S.

Secretary: E. W. A. Woolmer, B.A., C.A.

The first manufacturers of aircraft in the United Kingdom, the original firm of Short Brothers was established at Leysdown in 1909, with a contract to build six Wright biplanes.

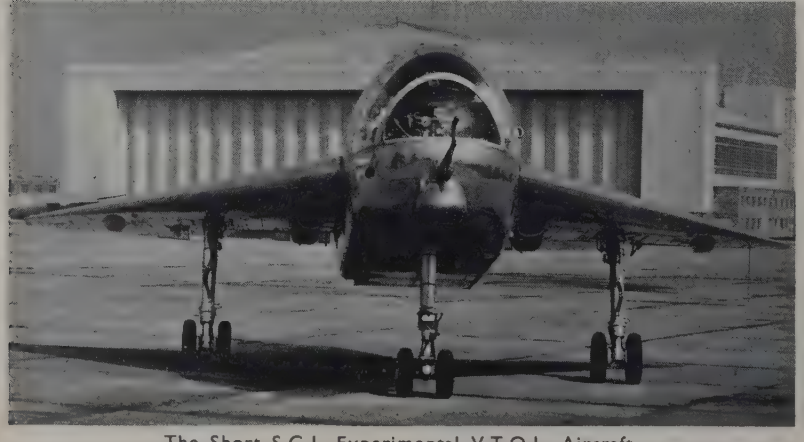
The brothers Short quickly gained a wide reputation and many naval aircraft of their design and manufacture flew in the 1914-18 war. After the war, the company pioneered all-metal construction and concentrated on the development of water-based aircraft at its works, which had been moved to Rochester.

In June, 1936, Short Brothers, in collaboration with Harland & Wolff, Ltd. the well-known shipbuilders, formed a new company known as Short & Harland, Ltd. to build aircraft in Belfast.

In September, 1947, as a result of Government policy, the company's major works at Rochester were closed and all its activities were concentrated at Belfast. Consequently the Rochester company, Short Brothers (Rochester & Bedford) Ltd., and the Belfast company were merged to form Short Brothers and Harland Ltd. of Belfast.

An important current product of this company is the S.C.1 vertical take-off and landing research aircraft, which is being developed for the Ministry of Supply.

Shorts are also building the English Electric Canberra jet bomber under direct contract from the Ministry of Supply, and the Britannia turboprop airliner, under an agreement with the Bristol Company.



The Short S.C.1. Experimental V.T.O.L. Aircraft.

The first Short-built Britannia flew on June 1, 1957.

In 1954 the Bristol Aeroplane Co., Ltd. acquired a small financial interest in Short Brothers & Harland, Ltd. and two directors of the Bristol company were invited to join the Board.

THE SHORT S.C.1.

The S.C.1 (originally known as the P.D.11) is an experimental delta-wing aircraft designed for research in the field of vertical take-off and landing. It is the first fixed-wing VTOL aeroplane to be built in Britain and, when its development programme is completed, will be capable of unrestricted vertical ascent and descent, and transition from hovering to forward flight.

The S.C.1 carried out taxi-ing trials in December, 1956 and made its first flight as a conventional aircraft at Boscombe Down on April 2, 1957, using normal take-off technique.

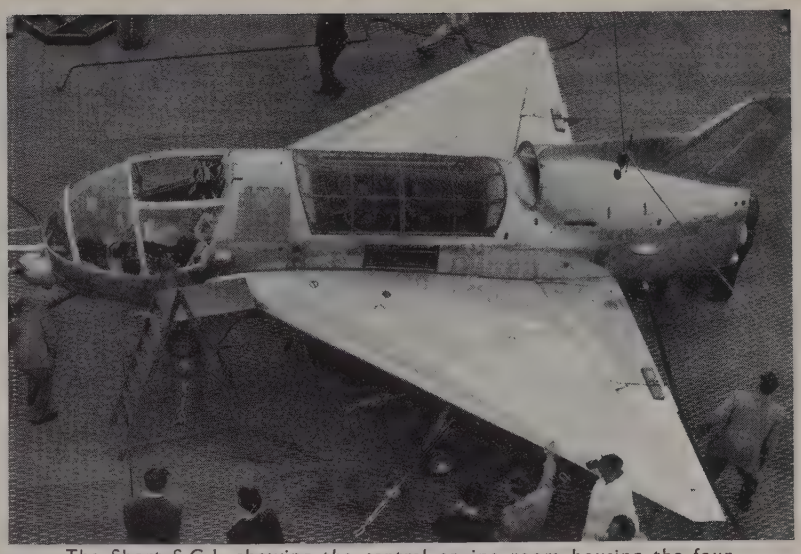
The flight marked the beginning of a series of tests, including hovering trials, in a specially-built gantry at Belfast. The first vertical take-off with the aircraft tethered was made on May 26, 1958, and the first free hovering flight within the gantry took place in August, 1958.

The S.C.1 was designed and built under contract from the Ministry of Supply. Short Brothers & Harland are handling all development work on the aircraft, including the auto-stabiliser and control systems, which were developed in conjunction with the Royal Aircraft Establishment

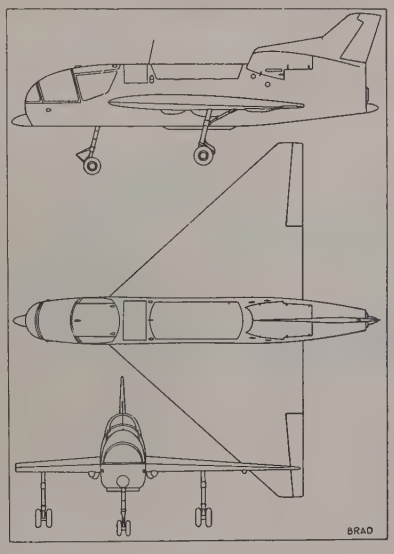
The aircraft, which has a delta-wing planform with no tailplane, is powered by five Rolls-Royce RB.108 turbojet engines. Four of these are positioned vertically in a central engine room to provide lift, while the fifth exhausts horizontally at the tail for thrust in forward flight.

The four lifting engines are mounted in crosswise pairs, each pair swinging on an axis so that the thrust centre can be directed either fore or aft at transition from vertical to forward flight, or *vice-versa*. After vertical take-off the engines are inclined backwards to give added forward thrust, and before vertical landing they can be moved forward to give a braking effect.

All five engines have a compressor bleed supplying high pressure air to a common duct which feeds air nozzles used for stability control in hovering flight. These control nozzles are positioned at the wing tips, nose and tail.



The Short S.C.1. showing the central engine room housing the four vertically-mounted engines.



The Short S.C.1.

Emission of air from the nozzles is controlled by the aircraft's electro-hydraulic auto-stabiliser.

A research undertaken with the S.C.I. is expected to be applicable to the design of supersonic V.T.O.L. aircraft.

DIMENSIONS.—
Span 23 ft. 6 in. (7.16 m.).
Length 24 ft. 5 in. (7.44 m.).

THE SHORT S.B.5.

The S.B.5 is a research aircraft which was designed and built at the request of the Ministry of Supply for the investigation of problems associated with the low-speed handling characteristics of swept-back wings.

The S.B.5 was designed so that varying degrees of sweepback can be tested. The tailplane can also be positioned either at the extreme top of the fin or beneath the rear fuselage and its angle of incidence is variable.

The varying degrees of sweep-back angle are achieved by fitting alternative components and four configurations can be tested. These are 50° wing sweepback with high tail-unit; 60° sweepback with low tail-unit; 60° sweepback with high tail-unit; and 69° sweepback with high tail-unit. The angle of incidence of the tailplane can be varied in flight from 10° above to 10° below the horizontal. The position of the non-retracting nose-wheel landing-gear can be changed to enable each configuration to be tested at various C.G. positions.

The S.B.5 has completed a series of tests with 50° and 60° sweepback—in the latter configuration with both high and low set tailplane—while powered by a Rolls-Royce Derwent turbojet engine. At the time of writing this aircraft was being re-engined with a Bristol Orpheus turbojet prior to testing the 69° sweepback configuration.

The S.B.5 is mainly of all-metal construction, the leading and trailing-edges of the wings being plywood-covered. The pilot's cockpit, which is forward of the wings, is provided with an ejector seat. Anti-spin and braking parachutes are fitted.

The S.B.5 was responsible for all the low-speed research carried out in the development of the English Electric P.1 fighter.

DIMENSIONS.—
Span (50° configuration) 35 ft. 2¼ in. (10.74 m.).
Span (60° configuration) 30 ft. 6 in. (9.30 m.).
Span (69° configuration) 25 ft. 11¾ in. (7.92 m.).
Overall length 47 ft. 4 in. (14.43 m.).
Max. Height (high tailplane) 16 ft. 7 in. (5.0 m.).
Max. height (low tailplane) 15 ft. (4.57 m.).



The Short S.B.5 with 60° wing sweepback and high tail.

SLINGSBY

SLINGSBY SAILPLANES, LTD.

HEAD OFFICE AND WORKS: KIRBY-MOORSIDE, YORKSHIRE.

Directors: F. N. Slingsby, M.M., A.F.R.Ae.S. (Managing), G. E. Shaw, G. Dixon, J. R. H. Shaw.

THE SLINGSBY TYPE 45 SWALLOW.

The Swallow is intended to meet the need for a moderately-priced sailplane with a good performance for club and private owner use.

The prototype first flew on October 11, 1957, and full production was scheduled for May, 1958.

TYPE.—Single-seat Sailplane.

WINGS.—Cantilever monoplane. NACA 63_3618 laminar-flow section. Aspect ratio 12.6. Chord 5 ft. (1.52 m.) at root, 1.68 ft. (0.51 m.) at tip, 3.41 ft. (1.04 m.) mean. Dihedral 3.3°. Incidence at root 4°. Spruce and plywood structure with single spar and nose torsion box. Unbalanced wood-framed and fabric-covered ailerons. Total area of ailerons 15.8 sq. ft. (1.47 m.²). Gross wing area 145.9 sq. ft. (13.55 m.²).

FUSELAGE.—Forward portion is a plywood semi-monocoque, rear portion is a braced structure of spruce and plywood.

TAIL UNIT.—Cantilever monoplane type. Wood frames with fin and tailplane plywood-covered and elevators and rudder fabric-covered. Areas: fin 7.7 sq. ft. (0.71 m.²), rudder 7.5 sq. ft. (0.69 m.²), tailplane 12.4 sq. ft. (1.15 m.²), elevators 10.8 sq. ft. (1.06 m.²). Span of tail 9 ft. 3½ in. (2.8 m.).



The Slingsby Type 41 Skylark 2 single-seat Sailplane.

LANDING GEAR.—Unsprung single wheel and rubber-spring skid.

ACCOMMODATION.—Single-seat enclosed cockpit.

DIMENSIONS.—
Span 42 ft. 9½ in. (13.05 m.).
Length 23 ft. 2 in. (7.04 m.).
Height 5 ft. 2½ in. (1.58 m.).

WEIGHTS.—
Tare weight 425 lb. (193 kg.).
Disposable load (max.) 275 lb. (125 kg.).
Weight loaded (max.) 700 lb. (318 kg.).

PERFORMANCE (at 630 lb.—285 kg. A.U.W.).
Max. glide ratio 26 : 1 at 49 m.p.h. (79 km.h.).
Max. sinking speed 2.52 ft./sec. (0.7 m./sec.) at 41.5 m.p.h. (67 m.p.h.).
Speed when sink speed is 6 ft./sec. (1.8 m./sec.) 74.5 m.p.h. (119 km.h.).
Stalling speed 36 m.p.h. (58 km.h.).

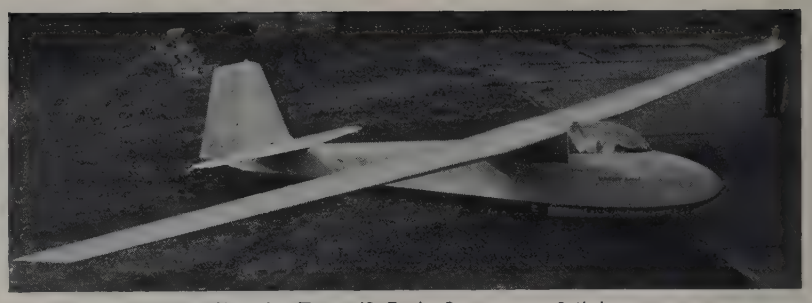
THE SLINGSBY TYPE 42 EAGLE 3.

The Type 42 high-performance two-seat sailplane first flew in prototype form in June, 1954. The first production Type 42 followed in April, 1956. The Eagle 3 won the two-seater class at the 1956 International Gliding Contests in France.

TYPE.—High-performance two-seat Sailplane.

WINGS.—High-wing cantilever monoplane. Wing sections NACA 63 618 at root, NACA 4412 at tip. Aspect ratio 14.8 to 1. Chord 60 in. (1.52 m.) at root, 28.5 in. (0.72 m.) at tip. Dihedral 2° on outer wings. Incidence 5° at root. All wood structure comprising main spar and light rear spar. Plywood covering to rear spar. Fabric-covered trailing-edge. Plain plywood-covered ailerons. Gross wing area 229 sq. ft. (21.3 m.²).

FUSELAGE.—Braced girder wooden construction. Nose covered with fiberglas and plywood. Rear fuselage fabric-covered.



The Slingsby Type 42 Eagle 3 two-seat Sailplane.

TAIL UNIT.—Cantilever monoplane type. All-wood framework with plywood-covered fin and tailplane, fabric-covered rudder and elevator. Areas: fin 11.8 sq. ft. (1.09 m.²), rudder 9.8 sq. ft. (.91 m.²) tailplane 25.56 sq. ft. (2.37 m.²), elevator 15 sq. ft. (1.39 m.²). Tailplane span 12 ft. 2 in. (3.70 m.).

LANDING GEAR.—Mono-wheel type, with single landing wheel terminating a single centrally-placed skid under forward fuselage. Tailskid at base of fin.

ACCOMMODATION.—Tandem cockpit forward of wing, with transparent canopy. Provision for back-type parachutes.

DIMENSIONS.—
Span 58 ft. 3 in. (17.75 m.).
Length 27 ft. 11 in. (8.5 m.).
Height 6 ft. (1.83 m.).

WEIGHTS.—
Weight empty 800 lb. (363 kg.).
Weight loaded 1,240 lb. (563 kg.).

PERFORMANCE.—
Best glide ratio 31 : 1 at 49.5 m.p.h. (79.7 km.h.).
Min. sink speed 2 ft./sec. (0.61 m./sec.) at 49 m.p.h. (78.7 km.h.).
Speed at sink of 6 ft./sec. (1.83 m./sec.) 79 m.p.h. (128 km.h.).
Min. speed at max. weight 36.5 m.p.h. (58.7 km.h.).

THE SLINGSBY TYPE 41 SKYLARK 2.

TYPE.—Single-seat Sailplane.

WINGS.—High-wing cantilever monoplane. Wing sections NACA 63_3620 at root, NACA 4415 at tip. Aspect ratio 16 : 1. Chord 42 in. (1.06 m.) at root, 23 in. (0.58 m.) at tip. Dihedral 2°. Incidence 5° at root. All-wood structure comprising main spar and light rear spar, plywood covering to rear spar, fabric-covered trailing-edge. Plain plywood-covered ailerons. Total aileron area 17.94 sq. ft. (1.66 m.²). Gross wing area 144 sq. ft. (13.37 m.²).

FUSELAGE. — Semi-monocoque elliptical-section structure with spruce frames and plywood skin.

TAIL UNIT.—Cantilever monoplane type. All-wood framework with plywood-covered fin and tailplane. Fabric-covered rudder and elevators. Areas: fin 7.38 sq. ft. (0.68 m.²), rudder 7.5 sq. ft. (0.70 m.²), tailplane 12.6 sq. ft. (1.17 m.²), elevators 9.95 sq. ft. (0.92 m.²). Span of tail 9 ft. 3½ in. (2.82 m.).

LANDING GEAR.—Central skid and main landing wheel, and small tail-skid at base of rudder-post.

ACCOMMODATION.—Single enclosed cockpit. Back-type parachute.

DIMENSIONS.—
Span 48 ft. (14.64 m.).
Length 24 ft. 6 in. (7.47 m.).
Height 5 ft. (1.52 m.).

WEIGHTS.—
Weight empty 444 lb. (201.5 kg.).
Weight loaded 680 lb. (309 kg.).

PERFORMANCE.—
Best glide ratio 30 : 1 at 43 m.p.h. (68.8 km.h.).
Min. sinking speed 2.3 ft./sec. (0.7 m./sec.).
Speed at sink of 6 ft./sec. (1.8 m./sec.) 73.3 m.p.h. (117.2 km.h.).
Min. speed at max. weight 36.7 m.p.h. (58.7 km.h.).

THE SLINGSBY TYPE 43 SKYLARK 3B.

The Type 43 is the latest version of the Skylark, with increased wing span and enlarged tail surfaces. Skylark 3's took five of the first six places, including the first, in League I of the British 1957 National Gliding Championships.

Structural details are as for the Type 41 Skylark 2, with the following exceptions:—

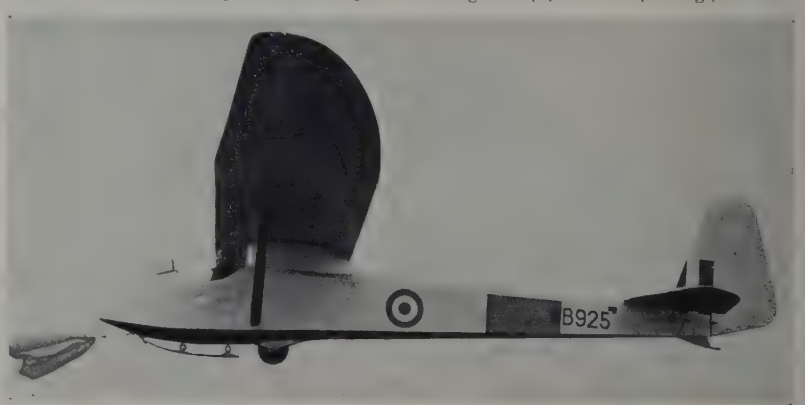
WINGS.—Aspect ratio 20.5 : 1. Wing area 173 sq. ft. (16.0 m.²).

TAIL UNIT.—Areas: fin 10.5 sq. ft. (.97 m.²), rudder 9.6 sq. ft. (.89 m.²), tailplane 16 sq. ft. (1.49 m.²), elevator 11.8 sq. ft. (1.10 m.²). Tailplane span 9 ft. 5½ in. (2.88 m.).

LANDING GEAR.—Can have skid and droppable landing gear as alternative to skid and mono-wheel.

DIMENSIONS.—
Span 59 ft. 7 in. (18.16 m.).
Length 25 ft. (7.6 m.).
Height 5 ft. 9 in. (1.75 m.).

WEIGHTS.—
Weight empty 546 lb. (248 kg.).



The Slingsby Type 21B Sedbergh TX. Mk. 1 Training Glider.

Weight loaded 790 lb. (358 kg.).

PERFORMANCE.—
Best glide ratio 36 : 1 at 46 m.p.h. (74 km.h.).
Min. sink speed 1.85 ft./sec. (.56 m./sec.) at 40 m.p.h. (65 km.h.).
Speed at sink of 6 ft./sec. (1.83 m./sec.) 78 m.p.h. (126 km.h.).
Min. speed at max. weight 36.2 m.p.h. (58.3 km.h.).

THE SLINGSBY TYPE 21B SEDBERGH.

The Type 21B is a two-seat side-by-side training glider which has been designed to meet the requirements for a simple type of dual instruction sailplane of medium performance and low price, suitable for gliding clubs and other training organizations.

The Type 21B is in service with the Air Training Corps. In its service form it is named the Sedbergh TX Mk. 1.

TYPE.—Two-seat Training Glider.

WINGS.—High-wing braced monoplane. Single-spar torsion-resisting nose-box structure with light secondary spar to carry ailerons. Wood construction with fabric covering aft of main spar. Single bracing struts on each side. Standard mean chord 4 ft. 9¾ in. (1.47 m.). Aspect ratio 11.2. Gross wing area 260 sq. ft. (24.15 m.²).

FUSELAGE.—Of mixed construction. Forward portion back to two main wing attachment-frames of wood stressed skin construction, remainder of fabric-covered girder construction.

TAIL UNIT.—Braced tailplane. Rudder and elevators are fabric-covered. Span 12 ft. 6¾ in. (3.67 m.).

LANDING GEAR.—Single central skid followed by single wheel. Spring tail-skid.

ACCOMMODATION.—Open cockpit seating two side-by-side with dual controls. Provision for back-type parachutes. Two control columns and dual rudder pedals. Quick-release and lift-spoiler controls placed centrally.

EQUIPMENT.—Instruments include A.S.I., Kollsman sensitive altimeter, Cobb-Slater variometer and Pullen electric turn-and-bank indicator. "Ottfur" type towing attachment mechanism.

DIMENSIONS.—
Span 54 ft. (16.47 m.).
Length 26 ft. 8 in. (8.13 m.).

WEIGHTS.—
Tare weight 590 lb. (268 kg.).
Disposable load 460 lb. (210 kg.).
Weight loaded 1,050 lb. (478 kg.).

SUPERMARINE

VICKERS-ARMSTRONGS (AIRCRAFT) LTD. (Supermarine Works).

WORKS: HURSLEY PARK, WINCHESTER, HANTS, AND SOUTH MARSTON, SWINDON, WILTS.

LONDON OFFICE: VICKERS HOUSE, BROADWAY, WESTMINSTER, S.W.1.

Directors: See under "Vickers."

Director and General Manager (Supermarine Works): S. P. Woodley, M.B.E.

Chief Designer (Supermarine Works): A. N. Clifton, M.B.E., B.Sc., F.R.Ae.S.

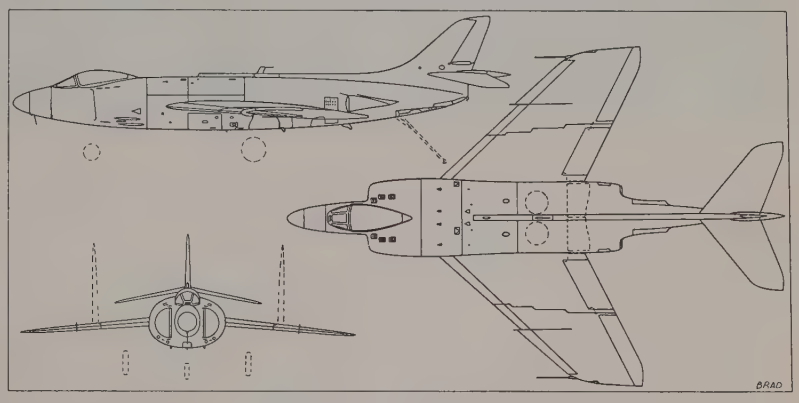
The original Supermarine Company was formed in 1912 and its efforts were chiefly devoted to the production of sea-going aircraft.

In November, 1928, Vickers (Aviation) Ltd. took over the control of the Supermarine Aviation Works, Ltd. In October, 1938, the Supermarine Aviation Works (Vickers), Ltd., was, with its parent company Vickers (Aviation), Ltd., taken over by Vickers-Armstrongs, Ltd.

On January 1, 1955, a new Vickers-Armstrongs subsidiary, Vickers-Armstrongs (Aircraft), Ltd., took over the aircraft business previously carried on by the parent company.

Supermarine's first jet-propelled fighter, the Attacker, was supplied in numbers to the Royal Navy. A swept-wing version, the Type 510, was built for experimental purposes, and the Type 535 was a further development. This latter model was succeeded by the Swift, which is now in service in its Mk. 5 form in the Royal Air Force. A Mk. 7 version has been produced for operational testing of air-to-air missiles.

The latest Supermarine naval jet fighter is the Scimitar, a substantial order for which has been placed for the Royal Navy. It is a development of the Type 508, with the Type 525 serving as an interim development version. Details of these aircraft have appeared in earlier editions of "All the World's Aircraft," and the Scimitar itself is described hereafter.



The Supermarine Scimitar F. Mk. 1.

THE SUPERMARINE SCIMITAR.

Known originally as the Supermarine N.113, the Scimitar F. Mk. 1 is a large single-seat twin-engined Naval carrier-borne interceptor fighter and strike aircraft which is in production for the Royal Navy. It is a swept-wing monoplane and is powered by two Rolls-Royce Avon 200 Series turbojet engines which are mounted side-by-side amidships with the air intakes and jet exits on the sides of the fuselage fore and aft of the wings. The entire nose forward of the cockpit hinges to one side to give access to the nose-mounted radar scanner and to reduce the length of the aircraft for lift stowage. The wings have saw-tooth leading-edge and fences and an all-flying tail is fitted.

Production aircraft have a super-circulation, or "blown-flap," system wherein air ducted from the engine compressor is blown at supersonic speed over the upper surfaces of the flaps to increase lift by local acceleration of the airflow. This provides a considerable reduction in the deck-landing approach speed for aircraft-carrier operation and assists catapult take-off technique.

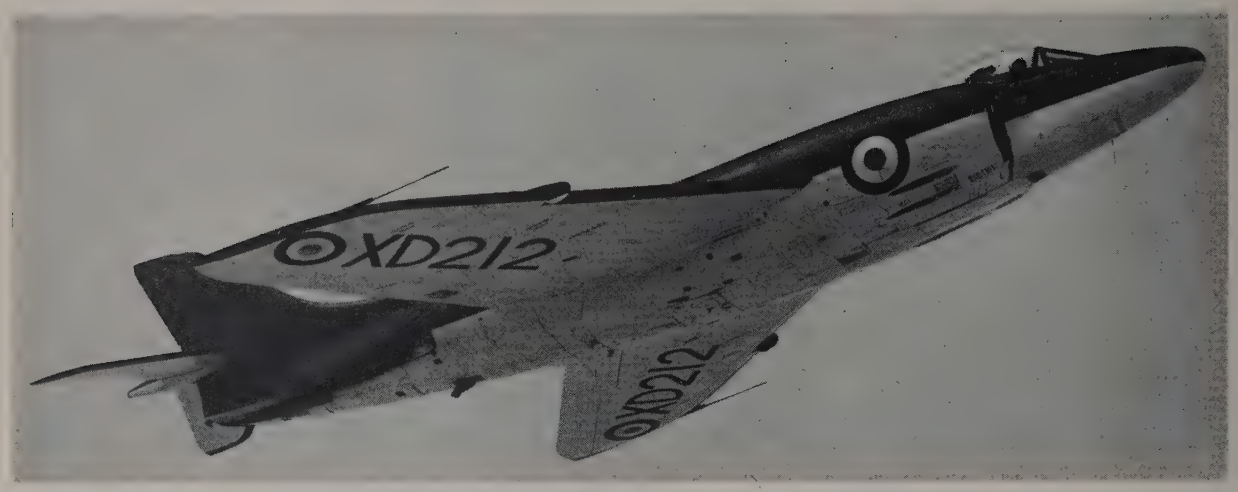
The prototype Scimitar flew for the first time on January 20, 1956 and deck-landing trials were successfully completed in H.M.S. *Ark Royal* in July, 1957.

The first operational squadron of Scimitars was formed in the Summer of 1958 and embarked in H.M.S. *Victorious* in the following September.

Initially, the Scimitar will be used as a day fighter. For this purpose the aircraft is armed with four 30 mm. Aden guns, radar-ranging gun-sight and the full range of operational equipment. Of equal priority is the "strike" rôle. In this case the Scimitar carries the "tactical" nuclear bomb, the necessary equipment for its accurate delivery and a



The Supermarine Scimitar F. Mk. 1 single-seat Interceptor Fighter and Strike Aircraft.



The Supermarine Scimitar F. Mk. 1 (two Rolls-Royce Avon turbojet engines).

number of external fuel tanks to give extended range.

Other duties for which the Scimitar will be used are those of ground attack, using conventional weapons such as bombs and rocket projectiles, and fighter reconnaissance, for which duty the Scimitar is equipped with the appropriate cameras.

DIMENSIONS.—
Span 37 ft. 2 in. (11.33 m.).
Width folded 20 ft. (6.10 m.).
Length 55 ft. 4 in. (16.87 m.).
Height 15 ft. 3 in. (4.65 m.).
Track 14 ft. 1 in. (4.30 m.).

THE SUPERMARINE SWIFT.

The Swift F. Mk. 5 is in service with the 2nd Tactical Air Force in Germany as a fighter-reconnaissance aircraft. Swift 5's provided the winner and runner-up in the 1957 low-level reconnaissance competitions held by N.A.T.O. in Germany.

There is also a Mk. 7, details of which are given below.

Swift F.R. Mk. 5. Rolls-Royce Avon engine with afterburner. Fighter reconnaissance version. Longer nose to accommodate camera equipment. Three F.95 cameras are usually installed. Armament consists of two 30 mm. Aden cannon. Provision for four rockets under each outer wing panel and for 220 Imp. gallon jettisonable fuel tank under fuselage.

Swift F. Mk. 7. For service trials of air-to-air guided weapons, and general assessment and training in guided weapon operational techniques. Guns replaced by extra fuel tanks. Nose and windscreen redesigned. Wing span increased by about 3 ft. (0.91 m.).

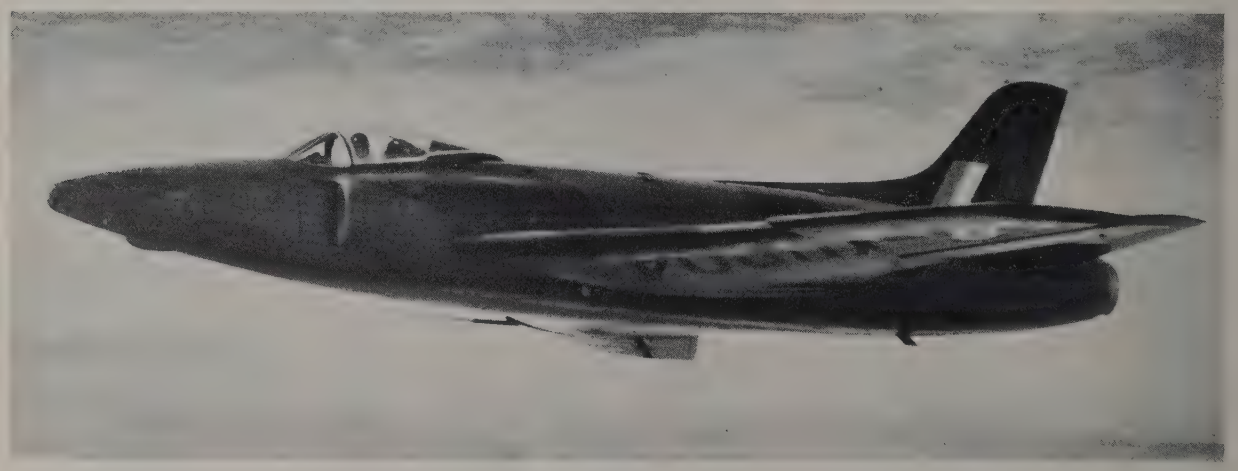
Details of the Swift Mk. 5 follow :—

TYPE. — Single-seat Fighter-Reconnaissance monoplane.

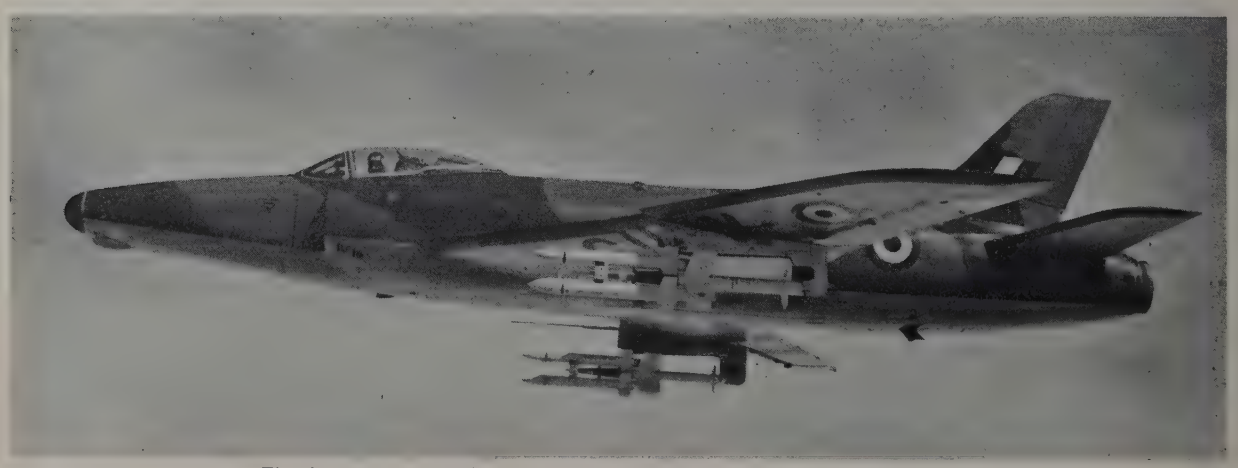
WINGS.—Low-wing cantilever monoplane. 40° sweepback at 25% chord line. Sawtooth leading-edges. All-metal structure. Gross wing area 306 sq. ft. (28.43 m.²).

FUSELAGE.—All-metal structure.

TAIL UNIT.—Cantilever monoplane type. All surfaces swept back. Variable incidence tailplane. Tailplane span 12 ft. 11 in. (3.93 m.).



The Supermarine Swift F.R. Mk. 5 Fighter-Reconnaissance Monoplane (Rolls-Royce Avon turbojet engine).



The Supermarine Swift F. Mk. 7 armed with two Fairey Fireflash missiles.

LANDING GEAR.—Retractable nose-wheel type. Hydraulic retraction. Wheel track 15 ft. 2½ in. (4.64 m.). Wheelbase 14 ft. 10 in. (4.52 m.).
POWER PLANT.—One Rolls-Royce Avon axial-flow turbojet engine with afterburner.
ACCOMMODATION.—Single-seat cockpit. Jettisonable canopy. Ejection seat.
ARMAMENT.—Two 30 mm. Aden cannon. Provision for four air-to-ground rockets under each outer wing panel.
DIMENSIONS.—
Span 32 ft. 4 in. (9.86 m.).
Length 41 ft. 5½ in. (12.63 m.).
Height 13 ft. 6 in. (4.11 m.).

VICKERS



Two Vickers Valiant B. (K.) Mk. 1 bombers linked together by their Flight Refuelling equipment.

VICKERS - ARMSTRONGS (AIRCRAFT) LIMITED.

AVIATION WORKS: WEYBRIDGE, SURREY, AND HURN, HANTS.
LONDON OFFICE: VICKERS HOUSE, BROADWAY, WESTMINSTER, S.W.1.
Affiliated Companies:
Vickers-Armstrongs (Australia) Pty. Ltd., Melbourne, South Australia.
Vickers-Armstrongs (South Africa) Pty. Ltd., Johannesburg.
Vickers (Eastern), Ltd., Bombay, India
Vickers-Armstrongs, Inc., Washington, D.C., U.S.A.

Directors: Major-General C. A. L. Dunphie, C.B., C.B.E., D.S.O. (Chairman); Sir George R. Edwards, C.B.E., B.Sc., F.R.Ae.S., A.M.I.Struct.E. (Managing Director); J. Anderson; T. Gammon, O.B.E., M.I.Mech.E.; E. J. Waddington, A.C.A.; H. H. Gardner, B.Sc., F.R.Ae.S. (Chief Engineer, Military Aircraft); A. W. E. Houghton; B. Stephenson, F.R.Ae.S. (Chief Engineer, Civil Aircraft); and S. P. Woodley.

Chief of Aeronautical Research and Development: B. N. Wallis, C.B.E., F.R.S., R.D.I., B.Sc. (Hon.), M.Inst. C.E., F.R.Ae.S.

Chief Engineer (Guided Weapons): Brigadier J. Clemow, M.A.

Vickers (Aviation), Ltd. was formed in July, 1928, when Vickers, Ltd. formed their Aviation Department into a separate subsidiary company to take over the manufacture of aircraft, aircraft accessories and equipment. In November, 1928, Vickers (Aviation), Ltd. took over the control of the Supermarine Aviation Works, Ltd.

In October, 1938, Vickers (Aviation), Ltd. and the Supermarine Aviation Works (Vickers), Ltd. were taken over by Vickers-Armstrongs, Ltd.

In December, 1954, as part of a reorganisation of Vickers-Armstrongs, Ltd., a new subsidiary company known as Vickers-Armstrongs (Aircraft) Ltd. was formed to acquire the aircraft business which was at that time carried on at Weybridge, Supermarine and other works. The take-over took place on July 1, 1955, although the acquisition was back-dated to January 1, 1955. The Board of Directors of the new company is as above.

Vickers aircraft were operated in the 1914-18 War and subsequently have covered a wide range of types in both military and civil spheres.

The last Valiant four-jet bomber was delivered to the R.A.F. on September 24, 1957, and production is now centred on the Viscount and Vanguard.

The 300th Viscount was delivered in April, 1958. At that time 390 Viscounts had been sold to 35 airlines, six governments and five private companies in 31 countries.

The first production Vanguard was due to fly before the end of 1958, while development of the VC10 long-range jet transport proceeds.

THE VICKERS VALIANT.

The Valiant is a four-jet high-performance swept-wing bomber, powered by four Rolls-Royce Avon turbojet engines, which can be supplemented for take-off by two de Havilland Super Sprite liquid-propellent rocket motors in jettisonable under-wing pods. The first prototype flew for the first time on May 18, 1951, and the second prototype made its maiden flight on April 11, 1952.

The mention of five versions of the Valiant is permitted. These are:—

Valiant B. Mk. 1. Four Rolls-Royce Avon RA.14 engines. First production model. Outward-retracting twin-wheel main landing-gear units. Fitted for flight refuelling. Crew of five.

Valiant B. (P.R.) Mk. 1. B. Mk. 1 equipped for photographic reconnaissance.

Valiant B. (P.R.) K. Mk. 1. Similar to B. Mk. 1 but equipped for triple rôle as bomber, photographic reconnaissance aircraft and flight refuelling tanker/receiver. Refuelling probe on fuselage nose.

Valiant B. (K.) Mk. 1. Four Rolls-Royce Avon RA.28 engines. Final production version.

Valiant B. Mk. 2. Developed from Mk. 1. Backward-retracting eight-wheel bogie landing-gear units housed, when retracted, in fairings extending beyond wing trailing-edge. Longer fuselage nose. Flew for the first time on September 4, 1953. Not proceeded with.

The Valiant B. Mk. 1 went into R.A.F. squadron service in 1955 and has been used for operational tests of Britain's atomic and thermo-nuclear bombs.

TYPE.—Four-jet medium bomber.
WINGS.—Shoulder-wing cantilever monoplane, with compound sweepback. Chord at root 35 ft. 6 in. (10.82 m.). Thickness/chord ratio 12% at root, 9% on outer wings. Conventional two-spar all-metal structure. Sealed internally-balanced powered ailerons. Double-slotted flaps in two sections on each wing, plus centre-section flaps under jet tail-pipes. Perforated air-brake in four sections under each wing aft of wheel-bay. Thermal de-icing of leading-edges. Wing area 2,362 sq. ft. (219.45 m.²).
FUSELAGE.—All-metal semi-monocoque structure. Large dielectric panel under nose.



The Vickers Valiant B. (K.) Mk. 1 (four Rolls-Royce Avon turbojet engines).

Air-flow spoilers extend forward of bomb-bay, and section of under-fuselage hinges up aft of bomb-bay to act as airflow deflector when it is open.

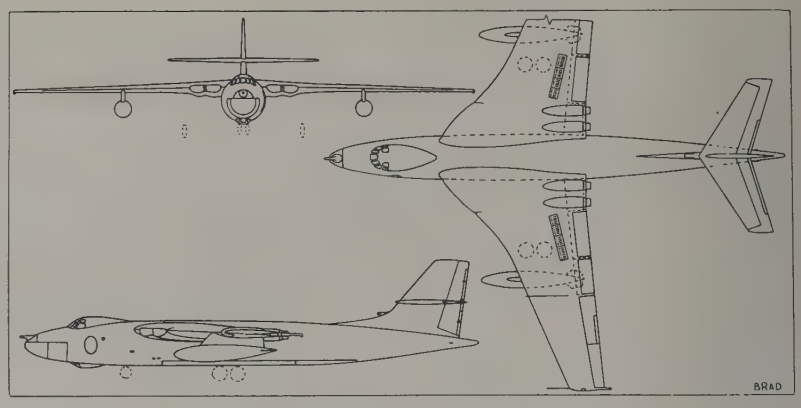
Tail Unit.—Cantilever monoplane type, with tailplane mounted mid-way up fin. All-metal structure. Nose of tailplane fixed, remainder variable-incidence. Power-operated rudder and elevators, each with balance tab. Additional trim-tab in rudder. Area of horizontal surfaces 380.5 sq. ft. (35.35 m.²). Area of vertical surfaces 263 sq. ft. (24.43 m.²). Span of tailplane 40 ft. 9 in. (12.42 m.).

Landing Gear.—Retractable tricycle type of Vickers design. Electrical actuation. Oleo-pneumatic shock-absorbers. Each main unit has two Dunlop wheels in tandem with Maxaret anti-skid braking. Twin nose-wheels. Electro-hydraulic multi-disc brakes and nose wheel steering. Wheel track 28 ft. (8.53 m.). Wheelbase 24 ft. 8 in. (7.51 m.).

Power Plant.—Four Rolls-Royce Avon R.A.28 Mk.204 turbojets (each giving 10,000 lb. = 4,540 kg. s.t.). Two D.H. Super-Sprite assisted take-off rocket packs can be mounted under the wings and jettisoned after burn-out. Fuel in bag tanks in fuselage and wings, can be supplemented by large under-wing tanks. Flight refuelling probe on nose of fuselage.

Accommodation.—Crew of five in pressurised compartment. Pilots side-by-side on Martin-Baker Mk. 3A ejection seats. Two navigators and an electronics officer on aft-fairing seats to rear. Entry door on port side of cabin. Bomb-aimer's prone position under cabin.

Dimensions.—
Span 114 ft. 4 in. (34.85 m.).
Length 108 ft. 3 in. (33.00 m.).
Height 32 ft. 2 in. (10.11 m.).



The Vickers Valiant B. (K.) Mk. 1.

THE VICKERS VC10.

A £60 million contract for 35 Vickers VC10 long/medium-range jet airliners was signed by B.O.A.C. in January, 1958. B.O.A.C. has also taken an option on a further 20 of these aircraft.

An earlier announcement of B.O.A.C.'s intention to place an order for VC10's was made in May, 1957, when the aircraft was stated to meet the Corporation's requirement for the African, Australian and Far Eastern routes from the mid 1960's onwards. Since then developments in the design of the aircraft, and in the power available from its four Rolls-Royce Conway engines, have made the VC10 an airliner which B.O.A.C. will use on the North Atlantic as well as on the Eastern Hemisphere routes, without impairing its efficiency on the latter services.

The VC10 will have four Rolls-Royce Conway engines mounted at the rear of the fuselage. It was the first aircraft ever designed so to group four engines, and thus to gain the performance advantages which can stem from having a clean wing unspoiled by engine nacelles or mountings of any kind. Such a wing can be designed to have a very advantageous lift/drag relationship, making for much improved take-off and better cruising economy. Another considerable advantage of the rear mounted engines is reduction of noise, vibration and jet exhaust buffet.

The VC10 will have a "double-bubble" fuselage with a top passenger deck capable of carrying up to 152 people in extra high density seating, up to 135 in standard high density, or 108 in a first class arrangement. Substantial underfloor freight capacity is provided.

The first VC10 will fly in the late Summer of 1961 and a fleet of the aircraft will be delivered to B.O.A.C. in 1963. The aircraft is being financed entirely by Vickers.

The only details of the VC10 which had been released at the time of writing are as follows :—

Dimensions.—
Span 140 ft. (42.7 m.).
Length 158 ft. (48.2 m.).
Height 41 ft. 2 in. (12.6 m.).
Fuselage width 12 ft. 4 in. (3.76 m.).
Width of passenger floor 11 ft. (3.35 m.).
Wing area 2,800 sq. ft. (260 m.²).

Weight (designed).—
Max. T.O. weight 299,000 lb. (135,750 kg.).

THE VICKERS VANGUARD 950 SERIES.

The Vanguard, plans for which were made public in October, 1955, is a completely new addition to the Vickers "family" of turboprop airliners. It is designed to offer fast and highly economic operation on all airline routes of up to 2,600 miles (4,160 km.), the design being based on Vickers' experience of meeting the requirements of over forty operators with the extremely successful Viscount.

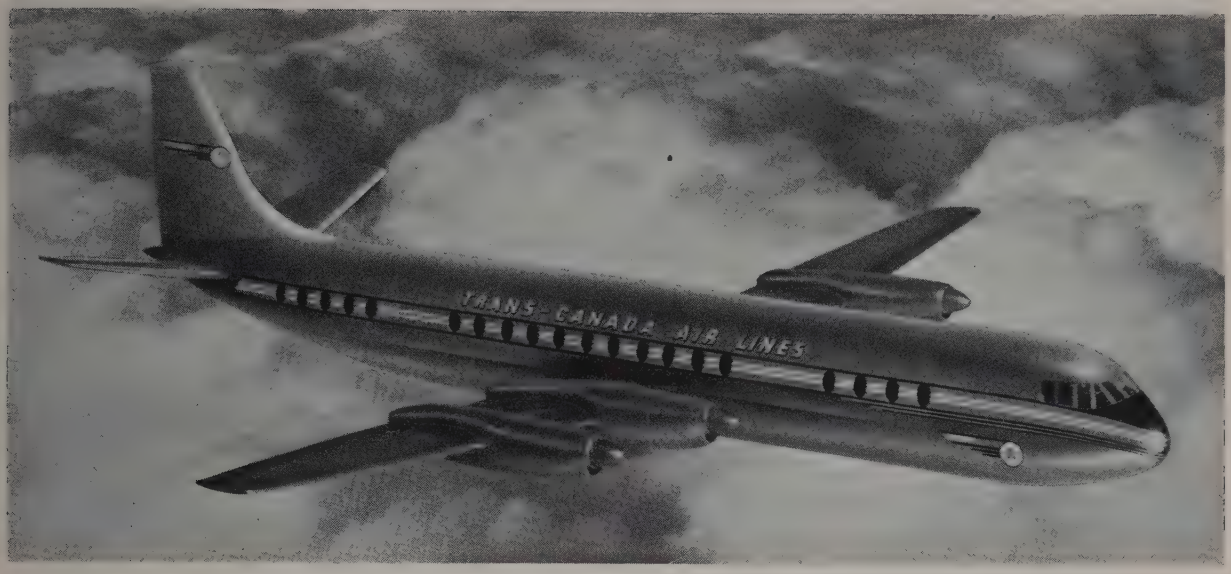
An important feature of the Vanguard is its "double-bubble" fuselage, providing accommodation for 97-139 passengers on the upper deck and unusually generous freight stowage in the two lower-deck cargo compartments. For off-peak or off-season operation these compartments can be filled with about 17,000 lb. (7,710 kg.) of normal density freight, enabling the Vanguard to carry a full payload with only 30 per cent. of its seats filled. Alternatively, the lower deck can be used for low-density freight.

The standard Vanguard will be based generally on the Type 952, which has been ordered by T.C.A. and of which some details are given below. Standard accommodation, will seat 97 passengers in a five-abreast layout, or 114 passengers in a mixed-class layout, a maximum of 139 seats being available in a coach class layout. Cabin and other dimensions are similar to those of Types 951 and 952.

British European Airways and Trans-Canada Air Lines have each ordered a



A model of the Vickers VC10 Jet Airliner, 35 of which have been ordered by B.O.A.C.



An impression of the Vickers Vanguard Airliner (four Rolls-Royce Tyne turboprop engines).

fleet of 20 Vanguards, in the following versions :—

Type 951. Ten for B.E.A. with Rolls-Royce Tyne RTy.1 turboprops rated at 4,500 s.h.p. plus 1,265 lb. (575 kg.) residual thrust. Remaining ten of B.E.A. order are Type 953 (which see).

Type 952. Twenty for Trans-Canada Air Lines. Four Rolls-Royce Tyne RTy. 11 turboprops each rated at 5,030 s.h.p. plus 1,290 lb. (586 kg.) residual thrust. Generally similar to Type 951, but with higher design weights and design cruising speed to give greater flexibility of operation. This version will operate at normal cruise power (13,500 r.p.m.) at altitudes down to 8,000 ft. (2,500 m.) in I.S.A. conditions and down to less than 5,000 ft. (1,500 m.) in I.S.A.+15°C. conditions at its max. "zero-fuel" weight.

Type 953. Rolls-Royce Tyne RTy.11 engines and increased payload. Ten for B.E.A.

There will not be a Vanguard prototype as such; the first aircraft built from production jigs was scheduled to fly in the Autumn of 1958. First deliveries of Vanguards are due in the Spring of 1960.

The following details apply specifically to the Vanguard Type 951 :—

TYPE.—Four-engined Airliner.

WINGS.—Mid-wing cantilever monoplane. NACA 63 Series (modified) wing section. Aspect ratio 9.1. Chord 17 ft. 1 in. (5.21 m.) at root, 6 ft. 5.8 in. (1.98 m.) at tip. Dihedral 6°. Incidence 2½°. Light-alloy torsion-box structure. Aerodynamically-balanced light-alloy ailerons. Hydraulically-operated Fowler-type light-alloy flaps inboard of ailerons. Thermal leading-edge anti-icing. Total area of ailerons 126 sq. ft. (11.71 m.²). Total area of flaps (flaps-up, projected) 314 sq. ft. (29.1 m.²). Gross wing area 1,529 sq. ft. (142.0 m.²).

FUSELAGE.—"Double-bubble" section. Pressurised. Conventional light-alloy construction using open frames and stringers.

TAIL UNIT.—Cantilever type. All-metal stressed-skin structure. Electrical anti-icing. Areas: fin (net) 237 sq. ft. (22.0 m.²), rudder 88 sq. ft. (8.2 m.²), tailplane 322 sq. ft. (29.9 m.²), elevators 130 sq. ft. (12.1 m.²). Tailplane span 47 ft. 8 in. (14.53 m.).

LANDING GEAR.—Retractable tricycle type with Vickers-type twin nose-wheel and twin-wheel main units. Hydraulic actuation. Dunlop or Goodyear wheels and hydraulic brakes with provision for anti-skid units. Wheelbase 40 ft. 6.35 in. (12.35 m.). Track (oleo centres) 30 ft. (9.15 m.).

POWER PLANT.—Four Rolls-Royce Tyne RTy.1 turboprop engines rated at (initially) 4,500 s.h.p. plus 1,265 lb. (575 kg.) residual thrust. de Havilland four-blade constant-speed and reversing airscrews 14 ft. 6 in. (4.42 m.) in diameter. Fuel in four integral tanks, two per wing. Inner tanks hold 1,880 Imp. gallons (8,535 litres) each, outer tanks 670 Imp. gallons (3,040 litres) each. Total fuel capacity 5,100 Imp. gallons (23,150 litres). Pressure under-wing fueling/defuelling system, plus overwing filler caps.

ACCOMMODATION (Type 951). — Standard accommodation for 76 (first class), 96 (standard) or 117 (tourist) passengers, three flight crew and four cabin attendants, but cabin arranged to provide maximum flexibility of seating arrangements combined with easy conversion to alternative layouts. Interior dimensions of cabin 90 ft. 2 in. long, 9 ft. 11 in. maximum floor width and 6 ft. 10 in. maximum height (27.28 × 3.02 × 2.08 m.). Standard main cabin is divided into three separate saloons with vestibule containing pantry in front and a toilet and wardrobe at aft end. Forward and central saloons separated by three toilets and wardrobe, and central and rear saloons by rear vestibule. Seats (for first-class version) are four abreast throughout, or (for tourist version) five abreast except last two rows where seats are four abreast. Hydraulically-operated built-in folding passenger stairs to forward and rear vestibules on port side. In lower segment of fuselage below cabin floor are two baggage and freight compartments, forward compartment of 750 cub. ft. (21.23 m³.) and rear compartment of 610 cub. ft. (17.27 m.³) capacity. Freight compartment headroom 4 ft. 3 in. (1.29 m.), freight doors 5 ft. 6 in. (1.67 m.) wide. Freight door sills approximately 4 ft. 9 in. (1.45 m.) above ground. Passenger cabin, flight deck and all freight and baggage compartments pressurised to maintain sea level conditions to 15,000 ft. (4,575 m.) and 8,000 ft. (2,400 m.) conditions to 30,000 ft. (9,150 m.). Cloud and collision-warning scanner in unpressurised nose section.

ACCOMMODATION (Type 952). — Standard accommodation for 96 first class or 110 tourist passengers; but cabin arranged to make possible a mixed class version of 70% tourist and 30% first class seating. Four washrooms and two galleys.

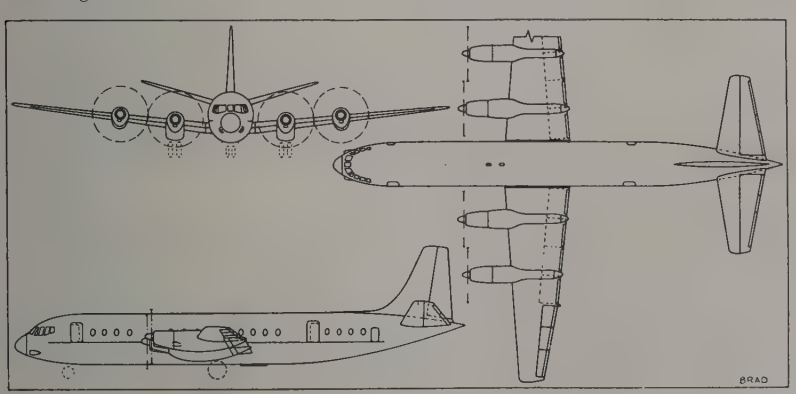
DIMENSIONS.—
Span 118 ft. (35.96 m.).
Length 122 ft. 10½ in. (37.38 m.).
Height 35 ft. (10.67 m.).

WEIGHTS (Type 951, designed).—
Weight empty 74,650 lb. (33,890 kg.).
Max. T.O. weight 135,000 lb. (61,235 kg.).
Max. landing weight 121,000 lb. (54,885 kg.).
Max. "zero fuel" weight 112,500 lb. (51,030 kg.).
Designed max. payload 29,000 lb. (11,340 kg.).
Designed max. payload (nominal) 21,000 lb. (9,525 kg.).
Current max. payload as limited by "zero fuel" weight 22,200 lb. (10,070 kg.).

WEIGHTS (Type 952, designed).—
Max. T.O. weight 141,000 lb. (63,956 kg.).
Max. landing weight 121,000 lb. (54,885 kg.).
Max. "zero fuel" weight 112,500 lb. (51,039 kg.).
Designed max. payload 29,000 lb. (13,150 kg.).

PERFORMANCE (Type 951, estimated).—
Cruising speed at 108,500 lb. (49,260 kg.) A.U.W. 400 m.p.h. (640 km.h.).
Still-air range with 21,000 lb. (9,535 kg.) payload, without reserves 3,150 miles (5,040 km.).
Still-air range with reserve fuel for one hour holding at 5,000 ft. (1,525 m.) and diversion of 230 miles (370 km.), plus 5% overall route reserve 2,600 miles (4,160 km.).

PERFORMANCE (Type 952, estimated).—
Cruising speed approx. 424 m.p.h. (680 km.h.).
Range with full payload and reserves 2,000 miles (3,220 km.).
Range with 19,100 lb. (8,663 kg.) payload, no reserves 3,400 miles (5,470 km.).



The Vickers Vanguard Airliner.

THE VICKERS VISCOUNT 700 SERIES.

The Viscount 700 Series comprises four basic versions, the 700, 700D, 770D and 771D.

The Type 700 was the original Viscount, the first production version (Type 701) going to B.E.A. in 1953. All Type 700 aircraft are now fitted with Dart 506 engines and cleared for an all-up weight of 60,000 lb. (27,240 kg.). They can also be modified to take the later 1,600 s.h.p. Dart 510 engines if required.

The Type 700D has the same airframe as the 700, but is fitted with four 1,600 s.h.p. Dart 510 engines, has increased fuel capacity (1,950 Imp. gallons = 8,850 litres) and an increased take-off weight (64,500 lb. = 29,300 kg.) and landing weight (57,500 lb. = 26,100 kg.).

The long-range version of the 700D has a 145 Imp. gallon (660 litre) slipper tank fitted under each wing outboard of the outer engine nacelles. Slipper tanks are filled through the main refuelling nozzle.

The 770D is the basic North American version of the 700D. It has all the standardised refinements and improved performance of the 700D but, in addition, it embodies North American equipment and the modifications needed to meet special CAA requirements.

The 771D is the basic "plush" version of the 770D and incorporates all the optional installations. These include built-in folding passenger stairs with front door passenger loading, racks for carry-on luggage, propeller brakes, Janitrol heater and a standard 48-seat cabin layout with two toilets.

Hereafter follows a complete listing of the Viscount 700/700D variants as they existed at the time of closing for press.

Type 700. Prototype (G-AMAV) of 700 Series. First flew on August 28, 1950. Has been used for development flying in connection with both Viscount and Vanguard development programmes.

Type 701. First production Viscount. Four Rolls-Royce Dart 505 (early aircraft) or 506 (later aircraft) turboprop engines. All now fitted with Mk. 506 engines. Twenty-seven for British European Airways. First production 701 flew on August 20, 1952. B.E.A. inaugurated the World's first turboprop-powered passenger services with Viscount 701 on April 18, 1953. Being progressively modified into 58-seaters for high-density routes as B.E.A.'s Series 800 Viscounts enter service.

Type 702. Four Rolls-Royce Dart 506 engines. Four for British West Indian Airways. 44-53 passenger configuration.

Type 707. Four Rolls-Royce Dart 505 engines. Mk. 506 engines fitted later. Four for Aer Lingus (Irish Air Lines). 53-seat interior.

Type 708. Four Rolls-Royce Dart 505 engines. Mk. 506 engines fitted later. Twelve for Air France. 49-seat interior.

Type 720. Four Rolls-Royce Dart 505 or 506 engines. Seven for Trans-Australia Airlines, first four with Dart 505 engines and last three with Dart 506 engines and slipper-type long range tanks. 44-seat interior.

Type 723. One for Indian Air Force. Dart 506 engines. 35-passenger transport with luxury interior (see also Type 730).

Type 724. Four Rolls-Royce Dart 506 engines. Fifteen for Trans-Canada Air Lines. 44-seat interior. Have special provisions for cold weather flying, including additional heating for passenger, crew and baggage compartments, increased electrical power, etc. Remaining thirty-six of T.C.A. fleet are Type 757 (which see).

Type 730. One for Indian Air Force. Dart 506 engines. V.I.P. interior for Presidential use.

Type 732. Three for Hunting-Clan Air Transport, Ltd. Dart 506 engines. 53-59 passenger layout. Formerly leased to Middle East Airlines.

Type 734. One V.I.P. aircraft for Pakistan Government for Presidential use. Dart 506 engines.

Type 735. Three for Iraqi Airways. Dart 510 engines. 44-53 passenger layout.

Type 736. Two ordered by Fred Olsen's Flyselskap A/S (Norway). Now owned by Airwork, Ltd. Dart 506 engines. 48-52 passenger layout.

Type 737. One for Canadian Department of Transport. For official use. Airframe same as Type 724 but with 22-seat V.I.P. interior.

Type 739. Three for Misrair S.A.E. (Egypt). Dart 506 engines. 40-seat interior.

Type 739A. Two for Misrair S.A.E. (Egypt).

Type 742. One (700D) originally for Braathen's S.A.F.E. (Norway), but now owned by the Brazilian Government and equipped for V.I.P. use. 52-seat interior. (See also Type 789).

Type 744. First three for Capital Airlines, ordered in June, 1954 were of this type. 44/48-seat interior. No longer in service. Two returned to Vickers in exchange for two 745's.

Type 745. Fifty-seven for Capital Airlines. Of these aircraft, first nine delivered with Dart 506 engines for subsequent conversion to 510 engines, remainder delivered with Dart 510 engines. 44/48-seat interior. One Type 745 also acquired by Canadian Department of Transport and nine by Northeast Airlines in 1958.

Type 747. Two for Butler Air Transport, Ltd. (Australia). Dart 506 engines. 40-seat interior. Transferred to Ansett-A.N.A.

Type 748. Five (700D) for Central African Airways Corporation. D.H. propellers. 47-seat interior. First two have provision for slipper tanks, last three delivered with slipper tanks.

Type 749. Three for Linea Aeropostal Venezolana. Dart 506 engines. 40-seat interior basically similar to Type 744.

Type 754. Seven for Middle East Airlines. 44/48-seat interior. Two leased to Kuwait Airways.

Type 755. Three ordered by Airwork, Ltd. and sold to Compañia Cubana de Aviacion prior to delivery. Dart 510 engines. 46-seat interior.

Type 756. Seven (700D) for Trans-Australia Airlines. Balance of order for fourteen, first seven being of Type 720 (which see).

Type 757. Thirty-six for Trans-Canada Air Lines. Dart 506 engines. Balance of order for a total of fifty-one; first fifteen being of Type 724 (which see).

Type 759. Two (700D) ordered by Hunting-Clan Air Transport, Ltd. but sold to Icelandair in 1957. 53-seat interior.

Type 760. Two (700D) for Hong Kong Airways. Fitted with slipper tanks. 40/44-seat interior.

Type 761. Three (700D) for Union of Burma Airways. 48-seat interior.

Type 763. One (700D) originally ordered by and built for Howard Hughes Tool Company of Delaware, U.S.A. but not taken up. Re-sale being negotiated at time of writing. Similar internal layout to Type 745.

Type 764. Three (700D) for United States Steel Corporation. Special long-range aircraft with two wing slipper tanks (145 Imp. gallons = 660 litres) and one fuselage "belly" tank (450 Imp. gallons = 2,045 litres). Executive interiors installed in the United States.

Type 765. One (700D) for Standard Oil Company of California. Executive



The Vickers Viscount Type 745 Airliner (four Rolls-Royce Dart turboprop engines) in Capital Airlines' colours.



The Vickers Viscount Type 754 Airliner (four Rolls-Royce Dart turboprop engines).

interior installed in United States. Fitted with 450 Imp. gallons (2,045 litres) belly tank.

Type 768. Ten (700D) for Indian Airlines Corporation. 44-seat interior.

Type 769. Three (700D) for PLUNA (Uruguay). 48-seat interior.

Type 772. Four for British West Indian Airways. Dart 506 engines. 48-seat interior.

Type 773. One (700D) for Iraqi Airways. 44-seat interior. Balance of order for four, first three being of Type 735 (which see).

Type 779. Four (700D) for Fred Olsen Airtransport. Leased to Austrian Airlines. 48-seat interior.

Type 781. One (700D) for South African Government. V.I.P. furnishing.

Type 782. Three (700D) for Government of Iran, two for Persian Air Services (48 seats) and one for personal use of The Shah.

Type 784. Two (770D) for Philippine Air Lines. One leased to TACA International Airline (El Salvador).

Type 785. Ten (770D) for Alitalia-L.A.I. 48-seat interior.

Type 786. Three (770D) originally ordered for Lloyd Aereo Colombiano but taken over by Kaysam Investment Corporation, of Miami, Fla. Two sold before delivery to La Nica (Lineas Aereas de Nicaragua). 48-seat interior.

Type 789. One for Brazilian Government. V.V.I.P. furnishings for Presidential use. Replaces earlier V.I.P. Type 742 (which see).

Type 794. Five for Turkish Airlines (THY).

The description below refers to the Viscount 700 Series in general.

TYPE.—Four-engined Airliner.

WINGS.—Low-wing cantilever monoplane. Aerofoil section NACA 63 modified. Aspect ratio 9.17. All-metal structure with stressed Alclad skin. Double-slotted flaps between Irving-type ailerons and fuselage. Thermal de-icing. Root chord 14 ft. 10 in. (4.54 m.). Tip chord 4 ft. 5 in. (1.35 m.). Dihedral 4° 30′. Aileron area 47.4 sq. ft. (4.4 m.²). Total flap area 156 sq. ft. (14.43 m.²). Gross wing area 963 sq. ft. (89.3 m.²).

FUSELAGE.—All-metal stressed-skin structure. The entire fuselage except nose-wheel retraction bay and extreme rear is pressurized to 6½ lb./sq. in. (0.45 kg./cm.²).

TAIL UNIT.—Cantilever monoplane structure. Single fin and rudder and 15° dihedral on tailplane. All-metal construction. Spring tabs in all control surfaces. Thermal de-icing. Total tailplane area 203 sq. ft. (18.8 m.²). Elevator area (including tabs) 104 sq. ft. (9.67 m.²). Fin area 62 sq. ft. (5.75 m.²). Rudder area 62 sq. ft. (5.75 m.²).

LANDING GEAR.—Retractable tricycle type, hydraulically-operated. All units have single Vickers shock-absorbers supporting twin wheels. Dunlop or Goodyear wheels and brakes. Wheel track 23 ft. 10 in. (7.27 m.); wheel base 24 ft. 10.6 in. (7.58 m.).

POWER PLANT.—Four 1,400 s.h.p. Rolls-Royce Dart 506 (700 Series) or 1,600 s.h.p. Dart 510 (700D Series) turboprop engines, each driving a four-blade Rotol or D.H. fully-feathering 10 ft. (3.05 m.) diameter airscrew. Total internal fuel capacity 1,720 Imp. gallons (7,810 litres) in bag-type tanks forward and aft of main wing spar. Water methanol system for boosted take-off; total capacity 75 Imp. gallons (340 litres).

ACCOMMODATION.—Normal accommodation for 40 passengers, but up to 59 can be seated in high-density version. Normal crew of three or four, comprising two pilots and one or two cabin attendants. Separate crew station for radio-operator/navigator optional; when not carried, radio and radar are operated by remote control from second pilot's seat. Pantry forward of main cabin, toilet compartment at the rear. Three large freight and luggage compartments, one forward of main cabin, capacity 110 cub. ft. (3.11 m.³) one aft with separate door on starboard side, capacity 204 cub. ft. (5.77 m.³) one below floor level forward, with two access doors, capacity 215 cub. ft. (6.08 m.³). Continuous main passenger cabin with seats each side of central gangway. Cabin height 6 ft. 5 in. (1.96 m.). Maximum width at arm-rest level is 9 ft. 5 in. (2.88 m.). Combined pressurization, air-conditioning and temperature control, giving ground-level conditions up to 15,000 ft. (4,575 m.) and 8,000 ft. (2,440 m.) conditions at 30,000 ft. (9,150 m.). Provision for external air conditioning when on ground.

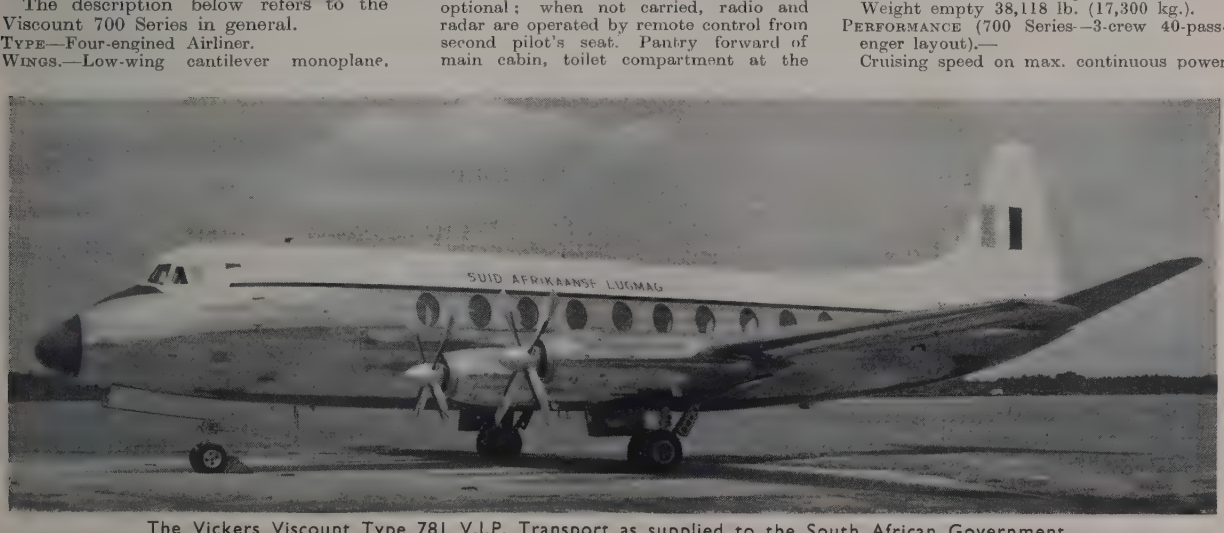
DIMENSIONS.—
Span 93 ft. 8½ in. (28.5 m.).
Length 81 ft. 9 in. (24.93 m.).
Height 27 ft. 9 in. (8.46 m.).

WEIGHTS (700 Series—3-crew 40-passenger layout).—
Weight empty (equipped—includes crew, oil, etc.) 36,859 lb. (16,718 kg.).
Max. payload and catering allowance 12,141 lb. (5,507 kg.).
Max. "zero fuel" weight 49,000 lb. (22,226 kg.).
Max. all-up weight 60,000-63,000 lb. (27,200-28,570 kg.) depending on modification state.
Max. landing weight 52,000-54,000 lb. (23,600-24,500 kg.) depending on modification state.

WEIGHTS (700D—2-crew, 40-passenger layout).—
Weight empty (equipped—includes crew, oil etc.) 37,918 lb. (17,200 kg.).
Max. payload and catering allowance 12,250 lb. (5,500 kg.).
Max. "zero fuel" weight 50,168 lb. (2,2800 kg.).
Max. all-up weight 64,500 lb. (29,250 kg.).

WEIGHTS (770D Series—North American basic version).—
As for 700D Series except:—
Weight empty 38,118 lb. (17,300 kg.).

PERFORMANCE (700 Series—3-crew 40-passenger layout).—
Cruising speed on max. continuous power



The Vickers Viscount Type 781 V.I.P. Transport as supplied to the South African Government.



The Vickers Viscount 790 "local service" Airliner (four Rolls-Royce Dart turboprop engines).

at 53,000 lb. (24,000 kg.) at 25,000 ft. (7,625 m.) under I.C.A.N. conditions 323 m.p.h. (517 km.h.).

Cruising speed on recommended power at 53,000 lb. (24,000 kg.) at 20,000 ft. (6,100 m.) under I.C.A.N. conditions 324 m.p.h. (518 km.h.).

Rate of climb on max. continuous power at 58,500 lb. (26,560 kg.), I.C.A.N. conditions flaps up, on four engines, 1,200 ft./min. (366 m./min.) at sea level and 700 ft./min. (202 m./min.) at 15,000 ft. (4,575 m.).

Rate of climb on take-off power at 58,500 lb. (26,560 kg.), I.C.A.N. conditions, 20° flap and landing gear up, take-off power and one engine inoperative 732 ft./min. (223 m./min.) at sea level, and 540 ft./min. (165 m./min.) at 6,000 ft. (1,830 m.).

Ceiling (based on rate of climb of 200 ft./min. = 61 m./min.) I.C.A.N. conditions at 52,000 lb. (23,608 kg.) on max. continuous power 28,500 ft. (8,680 m.).

Take-off distance to 50 ft. (15.2 m.) at 58,500 lb. (26,560 kg.), I.C.A.N. sea level conditions, four engines, 1,430 yds. (1,307 m.).

Take-off distance to 50 ft. (15.2 m.) at 58,500 lb. (26,560 kg.), I.C.A.N. sea level conditions, with one engine failure at critical point, 1,680 yds. (1,536 m.).

Landing distance from 50 ft. (15.2 m.) at 52,000 lb. (23,608 kg.), I.C.A.N. conditions, 950 yds. (870 m.).

Range and payload depend on operational requirement and fuel reserves.

PERFORMANCE (700D—2-crew, 40-passenger layout).—

Cruising speed on max. continuous power at 54,000 lb. (24,500 kg.) at 20,000 ft. (6,100 m.) under I.C.A.N. conditions 334 m.p.h. (534 km.h.).

Cruising speed on recommended power at 54,000 lb. (24,500 kg.) at 20,000 ft. (6,100 m.) under I.C.A.N. conditions 324 m.p.h. (518 km.h.).

Rate of climb on max. continuous power at 60,000 lb. (27,215 kg.) I.C.A.N. conditions, flaps up, on four engines 1,400 ft./min. (426 m./min.) at sea level and 700 ft./min. (213 m./min.) at 15,000 ft. (4,575 m.).

Rate of climb on take-off power at 60,000 lb. (27,215 kg.) I.C.A.N. conditions, 20° flap, landing gear up and one engine inoperative 750 ft./min. (229 m./min.) at sea level and 520 ft./min. (159 m./min.) at 6,000 ft. (1,829 m.).

Ceiling based on a rate of climb of 200 ft./min. = 61 m./min.) I.C.A.N. conditions at 54,000 lb. (24,500 kg) on max. continuous power 27,500 ft. (8,320 m.).

Take-off distance to 50 ft. (15.2 m.) at 60,000 lb. (27,215 kg.) I.C.A.N. sea level conditions, four engines, 1,320 yds. (1,210 m.).

Take-off distance to 50 ft. (15.2 m.) at 60,000 lb. (27,300 kg.) I.C.A.N. sea level conditions with one engine inoperative at critical point 1,550 yds. (1,416 m.).

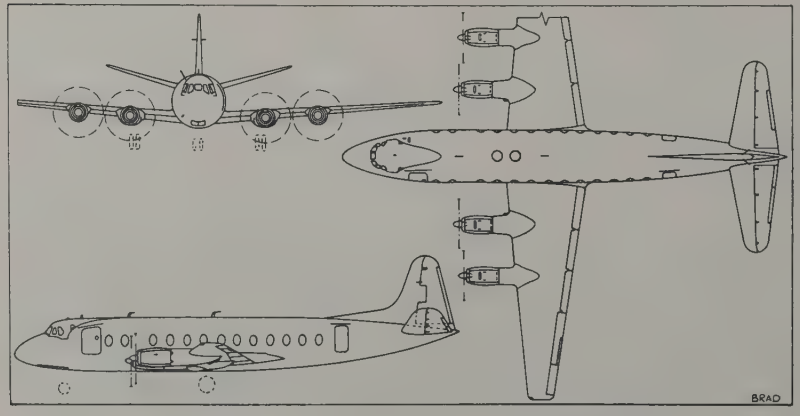
Landing distance from 50 ft. (15.2 m.) at 54,000 lb. (24,500 kg.) I.C.A.N. sea level conditions 1,023 yds. (936 m.).

Range and payload depend on operational requirements and fuel reserves.

THE VICKERS VISCOUNT 790.

The Viscount 790 embodies many special features which have been specially incorporated to produce a "local-service" Viscount, suitable for short haul work over stage lengths down to below 100 miles (160 km.). It is powered by four Rolls-Royce Dart Mk. 506 engines fitted with 140 activity factor Rotol propellers.

In the standard version the aircraft is capable of seating up to 54 passengers although layouts for up to 65 passengers are possible. Airsteps are fitted at the forward entrance door to facilitate on and off loading of passengers.



The Vickers Viscount 800 Series Airliner.

Compared with Viscounts now operating, the "local-service" Viscount has seating accommodation extending practically the whole length of the pressurised volume, more hard-wearing furnishings, revised trim to permit the use of high-density layouts, and re-arranged engine-driven accessories to permit loading of the freight holds while one engine is kept running.

WEIGHTS.—

Max. take-off weight 61,500 lb. (27,900 kg.).

Max. landing weight 58,500 lb. (26,500 kg.).

"Zero fuel" weight 50,000 lb. (22,700 kg.).

Capacity payload approx. 11,900 lb. (5,400 kg.) depending on customer requirements and layout.

PERFORMANCE.—

Cruising speed 320 m.p.h. (515 km.h.).

Still air range (with reserve fuel for 115 miles (185 km.) diversion, plus 45 minutes holding at 500 ft. (150 m.) 1,000 miles (1,600 km.).

THE VICKERS VISCOUNT 800 SERIES.

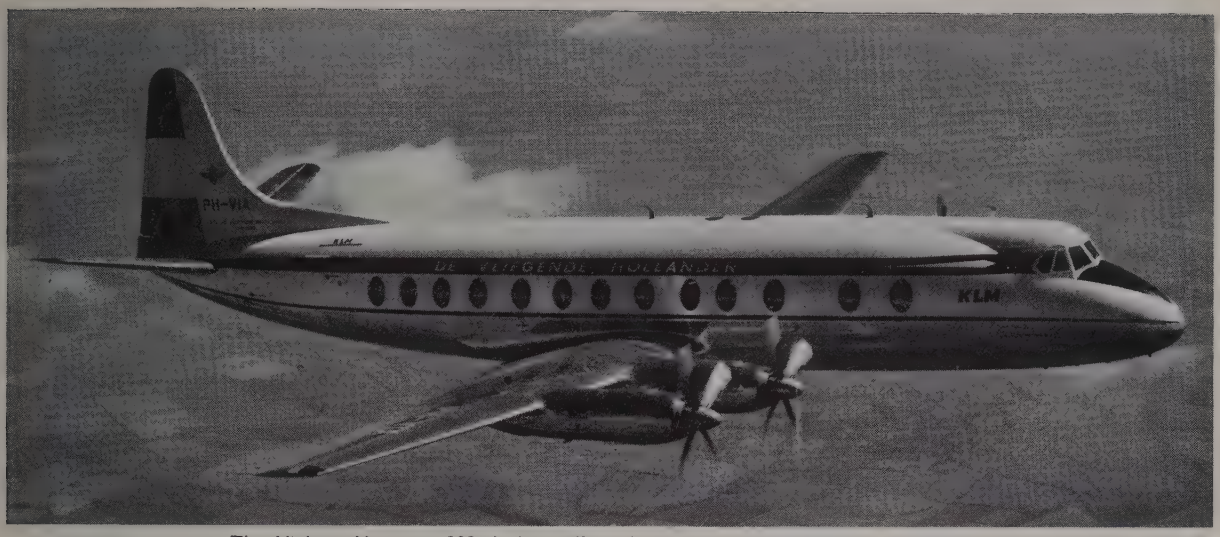
The Viscount 800 Series airliner is a "stretched" version of the 700, which is particularly suitable for high-density short-haul routes. It is not intended as a replacement of the 700 Series but as a complementary aircraft.

The first Series 800 Viscount, a Type 802 for B.E.A., made its first flight on July 27, 1956.

The fuselage of the 800 Series is 46 inches (1.17 m.) longer than that of the 700, while the rear pressure bulkhead has been moved aft by 65 inches (1.65 m.), giving a total extra cabin length of 111 inches (2.82 m.). This enables the aircraft to carry from 44 to 70 passengers as compared with the 40-54 seats of the 700 Series.

The seating arrangements in the 800 Series can be very flexible. Seventy passengers can be accommodated in twelve rows of five seats, two rows of four and one row of two. In a four-abreast arrangement there can be fourteen rows plus two extra seats (58 total) or, in an extra spacious layout, eleven rows of four (44 total).

One of the features of the 800 Series is that the pantry and forward bulkhead is mounted on rails so that the capacity of the cabin compartment can be adjusted between freight and passengers. When necessary the seats can be folded out of the way to make room for freight. The floor of the forward part of the cabin has been strengthened to take concentrated freight loads. To facilitate the loading of freight, the forward entrance door is rectangular and specially large.



The Vickers Viscount 803 Airliner (four Rolls-Royce Dart turboprop engines).

Except for the fuselage all other features, including wings and power-plant, are the same as for the 700D.

Type 802. Four 1,600 s.h.p. Rolls-Royce Dart RDa.6 (Mk. 510) engines. Twenty-four ordered by B.E.A. Fifty-seven-seat configuration with maximum sector distance with full load of 950 miles (1,520 km.). For shorter high-peak routes accommodation can be for either 65 or 70 passengers. Maximum payload in passengers and freight in this B.E.A. configuration is 12,744 lb. (5,479 kg.) for a range of 650 miles (1,040 km.) with full reserves. The first 802 entered service in February, 1957. Deliveries completed in 1957.

Type 803. Four Rolls-Royce Dart RDa.6 (Mk. 510) engines. Nine for K.L.M. Royal Dutch Airlines. Payload of 12,000 lb. (5,450 kg.) and a range with maximum payload of 600 miles (960 km.). 53/63-seat mixed-class interior. Deliveries completed in December, 1957.

Type 804. Four Rolls-Royce RDa.6 (Mk. 510) engines. 53/65-seat interior. Three for Transair, Ltd.

Type 805. Two for Eagle Aviation Ltd.

Type 806. As Type 802 but powered by four Dart RDa.7 (Mk. 520) engines to give increased cruising speed of 365 m.p.h. (587 km.h.). Not convertible to RDa.11 engines. Eighteen ordered by B.E.A. One fitted temporarily with Dart RDa.7/1 (Mk. 525) engines during 1957 for tropical trials as part of Viscount 810 Series development programme. Known as the Type 806/810, this aircraft (G-AOYF) flew for the first time on August 9, 1957. It is approved for operation at an A.U.W. of 69,000 lb. (31,300 kg.).

Type 807. Four Rolls-Royce Dart RDa.6 (Mk. 510) engines. Three ordered by New Zealand National Airways Corporation. 52/60-seat interior.

Type 808. Four Rolls-Royce Dart RDa.6 (Mk. 510) engines. Six ordered by Aer Lingus (Irish Air Lines). 58/65-seat interior.

DIMENSIONS.—
Same as 700 Series except:
Length 85 ft. (25.91 m.).

WEIGHTS (3-crew 52-seat layout).—
Weight empty (equipped—includes crew, oil, etc.) 40,776 lb. (18,496 kg.).
Max. payload and catering allowance 13,224 lb. (5,999 kg.).
Max. "zero-fuel" weight 54,000 lb. (24,494 kg.).
Max. take-off weight 63,000 lb. (28,576 kg.).
Max. landing weight 58,500 lb. (26,535 kg.).

PERFORMANCE.—
Cruising speed on max. continuous power at 55,000 lb. (24,950 kg.) at 20,000 ft. (6,100 m.) under I.C.A.N. conditions 325 m.p.h. (519 km.h.).
Cruising speed on recommended power at 55,000 lb. (24,950 kg.) at 20,000 ft. (6,100 m.) under I.C.A.N. conditions 314 m.p.h. (503 km.h.).
Rate of climb on max. continuous power at 62,000 lb. (28,120 kg.) I.C.A.N. conditions, flaps up, four engines, 1,220 ft./min. (372 m./min.) at sea level and 540 ft./min. (165 m./min.) at 15,000 ft. (4,575 m.).
Rate of climb on take-off power at 62,000 lb. (28,120 kg.), I.C.A.N. conditions, 20° flap, landing gear up and one engine inoperative 680 ft./min. (207 m./min.) at sea level and 460 ft./min. (140 m./min.) at 6,000 ft. (1,829 m.).
Ceiling (based on a rate of climb of 200 ft./min. = 61 m./min.) I.C.A.N. conditions at 55,000 lb. (24,950 kg.) on max. continuous power 27,000 ft. (8,230 m.).
Take-off distance to 50 ft. (15.2 m.) at 62,000 lb. (28,120 kg.) I.C.A.N. sea level conditions, four engines, 1,470 yds. (1,345 m.).
Landing distance from 50 ft. (15.2 m.) at 57,000 lb. (25,855 kg.) I.C.A.N. sea level conditions 1,120 yds. (1,024 m.).
Range and Payload depend on operational requirements and fuel allowances, but max. still air range with slipper tanks and max. payload will be 1,035 miles (1,756 km.).
Take-off distance to 50 ft. (15.2 m.) at 62,000 lb. (28,120 kg.) I.C.A.N. sea level with one engine inoperative at critical point 1,720 yds. (1,578 m.).

THE VICKERS VISCOUNT 810/840 SERIES.

These improved versions of the Viscount are the outcome of continuous development work on both the airframe and the Rolls-Royce Dart engine.



The Vickers Viscount 812 Airliner (four Rolls-Royce Dart turboprop engines).

The Viscount 810 is of similar external appearance to the Viscount 800 Series but is powered by Dart RDa.7/1 (Mk. 525) engines delivering 1,990 e.h.p. (1,800 s.h.p.) at take-off. These engines which are de-rated for take-off and therefore offer a reserve of power at high-altitude and high-temperature aerodromes will be available in 1958. By installing Dart RDa.11 (Mk. 541) engines (restricted to 2,100 s.h.p. to ensure maintenance of full power up to I.S.A. plus 10°C. at sea level, available in 1959, the Viscount 810 can be converted into the Viscount 840. Typical cruising speeds of these new versions will be 365 m.p.h.=584 km.h. (Type 810) and 400 m.p.h.=640 km.h. (Type 840).

By comparison with previous versions, the Viscount 810-840 Series incorporates structural modifications permitting them to operate at increased speeds and weights. Unlike the 800 Series they are not intended primarily for short-haul routes, being capable of operating with full payload over all stages from 200 to 1,650 miles (320 to 2,655 km.).

In standard form the Viscount 810-840 Series has first-class accommodation for 52 passengers, with standard seating for up to 65 tourist-class or 75 coach class passengers. The fuselage has provision for built-in passenger steps and nose-mounted radar.

Early production models, including the Type 812, are certificated for a loaded weight of 69,000 lb., but current versions have a max. weight of 72,500 lb. and the data below apply to this higher weight.

Type 810. One development aircraft (G-AOYV) for operation by Vickers.

Type 812. Fifteen for Continental Air Lines. 52-seat interior with rear lounge. Will be delivered with 1,800 s.h.p. Dart RDa.7/1 engines but will be re-engined in 1959 with 2,100 e.s.h.p. RDa.11 engines and will thus become Type 840.

Type 813. Seven for South African Airways. 56-seat interior.

Type 814. Nine for Deutsche Lufthansa. 54/60-seat interior.

Type 815. Three for Pakistan International Airlines. 51-seat interior. Slipper tanks.

Type 816. For Trans-Australia Airlines.

Type 818. Four for Compañia Cubana de Aviacion. 52-seat interior. Slipper tanks.

Type 819. One for Niarchos Group. Equipped as executive aircraft.

Type 825. Ordered by Black Lion Aviation. Order since transferred to another operator.

Type 827. Five for V.A.S.P. (Brazil).

Type 831. Two for Airwork, Ltd. 60-seat interior.

Type 832. Four for Ansett-A.N.A. (Australia).

Type 833. Three for Hunting-Clan. 64-seat interior.

DIMENSIONS.—
Same as 800 Series.

WEIGHTS (810 Series).—
Basic operational weight 41,276 lb. (18,722 kg.).
Max. payload and catering allowance 15,054 lb. (6,829 kg.).
Max. T.O. weight 72,500 lb. (32,886 kg.).
Max. "zero fuel" weight 57,500 lb. (26,082 kg.).
Max. landing weight 62,000 lb. (28,123 kg.).

PERFORMANCE (810 Series).—
Max. continous cruising speed, I.S.A., at 20,000 ft. (6,100 m.) and 60,000 lb. (27,216 kg.) A.U.W. 365 m.p.h. (584 km.h.).
Balanced field length, I.S.A., at S/L. 5,550 ft. (1,690 m.).
Landing distance from 50 ft. (15.25 m.), unfactored 3,300 ft. (1,005 m.).
Max. range with full fuel, 10,400 lb. (4,720 kg.) payload and reserves at 341 m.p.h. (549 km.h.) mean 1,650 miles (2,655 km.).
Range with max. payload and reserves 1,200 miles (1,930 km.).

WESTLAND

WESTLAND AIRCRAFT, LTD.

HEAD OFFICE, WORKS AND AERODROME: YEOVIL, SOMERSET.

LONDON OFFICE: 8, THE SANCTUARY, WESTMINSTER, S.W.1.

Directors: Eric Mensforth, C.B.E., M.A., M.I.Mech.E., F.R.Ae.S., M.I.P.E. (Chairman); Lord Aberconway (Deputy Chairman); Edward C. Wheeldon, M.I.P.E. (Managing Director); D. L. Hollis Williams, B.Sc., F.R.Ae.S. (Technical Director); D. C. Collins, M.I.Mech.E., M.I.P.E. (Works Director); Walter Oppenheimer, F.C.A. (Finance); Sir George E. Bailey, C.B.E.; Sir Norman J. Hulbert, D.L., J.P. and General Sir Kenneth Crawford, K.C.B., M.C.

Chief Engineer: O. L. L. Fitzwilliams, B.A. (Eng.), A.F.R.Ae.S.

Chief Designer: P. E. Q. Shunker, B.Sc., A.F.R.Ae.S., M.I.Ae.S.

Secretary: C. T. Jones, A.S.A.A.

Westland Aircraft, Ltd. was formed in July, 1935, to take over the aircraft branch of Petters, Ltd., previously known as the Westland Aircraft Works, which had been engaged in aircraft design and construction since 1915.

Since the war Westland has developed the Wyvern Naval strike aircraft and a series of helicopters, of which the first was the Sikorsky S-51, built under licence as the Westland Dragonfly.

Production of the Wyvern was completed in 1956, since when the whole of Westland's resources have been concentrated on the design, development and construction of helicopters. The company is now the largest manufacturer of helicopters in Europe.

Currently, Westland have in production four separate types of helicopters, the Widgeon, Whirlwind, Wessex and Westminster.

A subsidiary company, Normalair, Ltd., specialises in the design and manufacture of aircraft cabin atmosphere control systems, associated oxygen equipment and high-altitude breathing apparatus. Able to supply complete aircraft installations, Normalair, Ltd. are recognised as the foremost European authority in this field. All British pressurised aircraft, both civil and military, use Normalair equipment, as do many aircraft of foreign design.

THE WESTLAND WIDGEON.

The Widgeon is a developed version of the Dragonfly which has an entirely new forward fuselage to seat five. The power-plant is the Alvis Leonides 521/2 nine-cylinder air-cooled radial. The rotor head is of the type fitted to the larger Whirlwind helicopter and incorporates offset flapping hinges which give improved mechanical qualities and a greater C.G. range and eliminates ballasting for differing loading arrangements.

The cabin has a length of 6 ft. 3 in. (1.90 m.), height of 4 ft. 3 in. (1.30 m.), maximum width of 4 ft. 10 in. (1.47 m.) and floor width of 3 ft. 10 in. (1.16 m.). A clamshell door is provided on the port side of the nose for stretcher loading.

The Widgeon is available in four main versions: as a passenger carrier with accommodation for pilot and four passengers; as an ambulance to carry pilot, two stretcher cases entirely within the cabin and medical attendant; as a rescue aircraft with a hydraulically-operated winch; or as a freight transport able to carry an external load of up to 1,000 lb. (455 kg.). For anti-submarine duties there is a special blister attachment for housing the Soner gear. The versatility of each version can be extended by fitting Westland pontoon landing gear instead of wheels, for operation from



The Westland Widgeon five-seat Helicopter (500 h.p. Alvis Leonides engine).



A Westland Widgeon Helicopter (500 h.p. Alvis Leonides engine) equipped with flotation gear.

land and water. A further use is for crop-spraying for which a special installation is available.

Conversion from passenger to ambulance rôle has been achieved in as little as four minutes.

The Widgeon prototype made its first flight on August 23, 1955. Production Widgeons have been ordered by the Brazilian Navy, the Royal Jordanian Air Force, the Hong Kong Government and various civil operators.

TYPE.—Five-seat Single-rotor Helicopter.

ROTORS.—Three-blade main rotor and three-blade anti-torque tail rotor. Main rotor-blades of all-metal construction with area of 27.8 sq. ft. (2.58 m.²) each. Disc area of main rotor 1,900 sq. ft. (176.5 m.²). Blades attached to hub through offset flapping hinges. Hub is splined to drive-shaft, with top and bottom horizontal plates bolted to it. Three flapping and drag hinge units, spindles and sleeves to carry main blades, and three hydraulic dampers. Tail rotor of laminated wood construction with steel-sheathed leading edges. Disc area of tail rotor 55.65 sq. ft. (5.16 m.²). Vertical drive to main rotor runs from engine to centrifugally-operated clutch and fan unit, and through Hardy Spicer coupling to gear-box. Shaft drive from main gear-box through intermediate gear-box to tail rotor gear-box. Main rotor/engine r.p.m. ratio 1 : 11.88. Anti-torque rotor/engine r.p.m. ratio 1 : 1.80.

FUSELAGE.—Semi-monocoque light alloy cabin and tail cone, tubular steel centre section.

LANDING GEAR.—Three-wheel type with swivelling nose-wheel. Turner pneumatic shock-absorbers in main units. Westland oleo-pneumatic shock-absorber in nose-wheel unit. Dunlop Type AH8943 main wheels with 725 × 10 tyres. Dunlop Type AH8944 nose-wheel with 600 × 6.5 tyre. Tyre pressures 37 lb./sq. in. (2.60 kg./cm.²). Track 12 ft. (3.66 m.). Wheelbase 10 ft. (3.05 m.).

POWER PLANT.—One Alvis Leonides 521/2 nine-cylinder air-cooled radial engine, giving maximum power of 500 h.p. for five minutes at 3,000 r.p.m., maximum continuous power of 375 h.p. at 2,800 r.p.m. and maximum weak mixture power of 305 h.p. at 2,800 r.p.m. Mounted horizontally on tubular steel structure above centre-section bottom truss. Front and rear firewalls isolate engine bay from fuel tanks. Baffle plate above bay accommodates cooling fan. Fuel tanks forward and aft of engine bay, each with capacity of 41.6 Imp. gallons. Total fuel capacity 83.2 Imp. gallons (378 litres). A 33-gallon (30 litre) overload fuel tank installation has been approved to provide additional fuel capacity if needed. Oil capacity 8 Imp. gallons (36.6 litres).

ACCOMMODATION. — Enclosed cabin with normal accommodation for pilot and passenger side-by-side in front and rear bench seat for three persons. Alternatively can be equipped to carry two stretchers and medical attendant as well as pilot. Sliding door on each side of cabin. Clamshell door on port side of nose for stretcher loading.

DIMENSIONS.

Main rotor diameter 49 ft. 2 in. (14.99 m.).
Length of fuselage 40 ft. 10 in. (12.44 m.).
Overall width of fuselage 5 ft. 10 in. (1.77 m.).
Height to top of rotor pylon 13 ft. 2¾ in. (4.04 m.).
Anti-torque rotor diameter 8 ft. 5 in. (2.57 m.).

WEIGHTS.—

Weight empty 4,424 lb. (2,007 kg.).
Weight loaded 5,900 lb. (2,676 kg.).

PERFORMANCE.—

Max. speed at S/L. 104 m.p.h. (167 km.h.).
Cruising speed 81 m.p.h. (130 km.h.).
Rate of climb at S/L. 700 ft./min. (125 m./min.).
Service ceiling 10,500 ft. (3.190 m.).
Hovering ceiling 5,000 ft. (1,525 m.).
Max. range 310 miles (500 km.).

THE WESTLAND WHIRLWIND.

The Whirlwind exists in seven military versions. These are :—

Whirlwind H.A.R. Mk. 1. 600 h.p. Pratt & Whitney R-1340-40 engine. For Royal Navy.

Whirlwind H.A.R. Mk. 2. 600 h.p. Pratt & Whitney R-1340-40 engine. For Royal Air Force.

Whirlwind H.A.R. Mk. 3. 700 h.p. Wright R-1300-3 engine. For Royal Navy.

Whirlwind H.A.R. Mk. 4. 600 h.p. Pratt & Whitney R-1340-57 engine. For Royal Air Force.

Whirlwind H.A.R. Mk. 5. 750 h.p. (de-rated) Alvis Leonides Major Mk. 155 engine. For Royal Navy.

Whirlwind Mk. 6. A conversion of the Mk. 2 for the Royal Air Force by the installation of the Alvis Leonides-Major engine.

Whirlwind H.A.S. Mk. 7. Development of Mk. 5. First helicopter built in Britain specifically for anti-submarine duties. Carries equipment and weapons to detect, locate and destroy submarines, including homing torpedo in special open bay under cabin. To accommodate this, cabin floor has been raised and under-floor fuel tanks re-positioned on each side



The Westland Whirlwind H.A.S. Mk. 7 Naval Anti-Submarine Helicopter (750 h.p. Alvis Leonides Major engine).



The Westland Whirlwind Series 2 Civil Helicopter (750 h.p. Alvis Leonides Major engine).

of bay. First deliveries to Royal Navy in May, 1957.

A number of Sikorsky-built S-55 helicopters have been supplied to the Royal Navy under M.D.A.P. and these have been given designations in the "Whirlwind" series as follows :—

Whirlwind H.A.R. Mk. 21. Sikorsky-built HRS-2 transport helicopter in service in the Royal Navy. 550 h.p. Pratt & Whitney R-1340 engine.

Whirlwind H.A.S. Mk. 22. Sikorsky-built H04S-3 anti-submarine and rescue helicopter in service with the Royal Navy. 700 h.p. Wright R-1300 engine.

The naval versions of the Whirlwind can be fitted with a hook, attached to the rear of the cabin, for towing mine-sweeping gear.

The Westland Whirlwind in its Series 1 civil form, powered by the Pratt & Whitney R-1340 engine, has been supplied to British European Airways for passenger transport and to other European commercial organisations. The Series 2 civil version has an Alvis Leonides Major Mk. 755 engine.

The following specification applies generally to both the military and civil versions of the Whirlwind :—

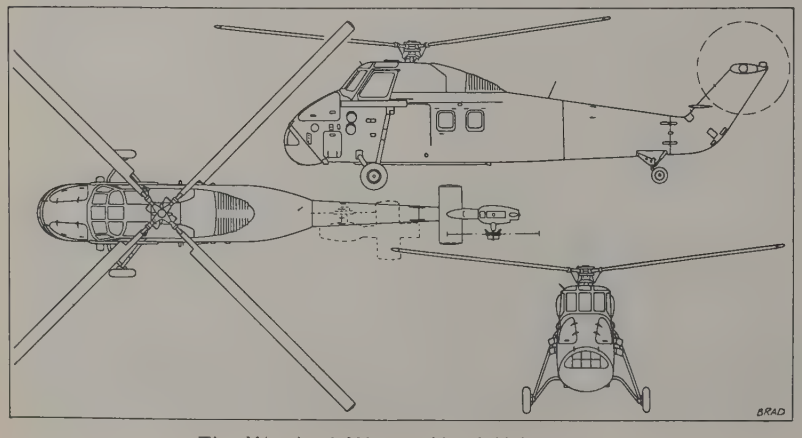
TYPE.—Military or Civil Helicopter.

ROTOR.—Three-blade main rotor, two-blade anti-torque tail rotor. Main rotor blades on offset flapping hinges with hydraulic damping about drag hinges. Swash-plate control mechanism. All-metal blades have extruded spars and light alloy skinned trailing-edges. Main rotor blade area 32.5 sq. ft. (3.02 m.²) each. Disc area of main rotor 2,206 sq. ft. (204.93 m.²). Disc area of tail rotor 61 sq. ft. (5.66 m.²). Main rotor drive by inclined shaft through helical bevel gears and double epicyclic reduction. Main rotor/engine r.p.m. ratio 11.3 : 1 (13.62 : 1 in versions with Leonides Major). Anti-torque rotor/engine r.p.m. ratio 1.62 : 1 (1.95 : 1 in versions with Leonides Major).

FUSELAGE.—Rectangular light alloy semi-monocoque structure with metal cone extension carrying tail rotor. All aircraft of later production series have drooped tail-cone, to give greater clearance between main and tail rotor blades, a spring-loaded tail-skid, repositioned stabilisers and a redesigned tail rotor pylon.

LANDING GEAR.—Four-wheel type, with forward pair of wheels castoring and rear pair taking main landing and brake loads. Turner air-oil shock struts. Dunlop wheels and brakes. Track 11 ft. (3.35 m.) main wheels, 4 ft. 6 in. (1.37 m.) nose wheels. Wheelbase 10 ft. 4 in. (3.15 m.).

POWER PLANT.—One 600 h.p. Pratt & Whitney R-1340-40 Wasp, 700 h.p. Wright R-1300-3 or 750 h.p. (de-rated) Alvis Leonides Major Mk. 155 or Mk. 755 radial air-cooled engine on inclined axis in nose compartment and driving main rotor gearbox by sloping shaft. Nose doors give access to engine installation. Fuel tanks under cabin floor with capacity of 145 Imp. gallons (657 litres) on versions with R-1340 and R-1300 engines, 170 Imp. gallons (773 litres) on versions with Leonides Major. Oil capacity 10 Imp. gallons (45 litres).



The Westland Wessex Naval Helicopter.

ACCOMMODATION.—Cockpit seating two side-by-side with dual controls in nose above engine. Main cabin 6 ft. × 10 ft. × 5 ft. 6 in. (1.82 m. × 3.05 m. × 1.67 m.) directly under rotor head can accommodate wide variety of loads, including 10 fully-armed troops, six stretchers, etc. Loading door 4 ft. × 4 ft. (1.22 m. × 1.22 m.) on starboard side. Power operated pilot-controlled hydraulic hoist for lifting loads while hovering. Cargo capacity 340 cub. ft. (9.6 m.³).

DIMENSIONS.—
Main rotor diameter 53 ft. (16.1 m.).
Overall length 62 ft. 1½ in. (18.95 m.).
Length of fuselage 41 ft. 8½ in. (12.71 m.).
Overall width 45 ft. 9½ in. (13.94 m.).
Height to top of rotor pylon 13 ft. 3 in. (4.04 m.).
Diameter of anti-torque rotor 8 ft. 11 in. (2.74 m.).

WEIGHTS (Civil Whirlwind).—
Weight empty 5,010 lb. (2,280 kg.).
Disposable load 2,490 lb. (1,130 kg.).
Weight loaded 7,500 lb. (3,420 kg.).

WEIGHTS (Mk. 1).—
Weight empty 5.286 lb. (2,400 kg.).
Disposable load 2,214 lb. (1,105 kg.).
Normal loaded weight 7,500 lb. (3,405 kg.).

WEIGHTS (Mk. 5).—
Weight empty 5,580 lb. (2,531 kg.).
Max. loaded weight 7,800 lb. (3,538 kg.).

PERFORMANCE (Mk. 1).—
Max. speed at S/L. 109 m.p.h. (176 km.h.).
Cruising speed 86 m.p.h. (138 km.h.).
Best rate of climb at S/L. 800 ft./min. (244 m./min.).
Service ceiling 7,000 ft. (2,130 m.).
Still air range 300 miles (480 km.).

PERFORMANCE (Mk. 5).—
Max. speed at S/L. 109 m.p.h. (176 km.h.).
Cruising speed for max. range 86 m.p.h. (139 km.h.).
Rate of climb at S/L. 1,080 ft./min. (330 m./min.).
Hovering ceiling 5,500 ft. (1,680 m.).
Range 335 miles (539 km.).

THE WESTLAND WESSEX.

The name Wessex has been given to a new helicopter which resembles the Sikorsky S-58 in general layout but is powered by a Napier Gazelle shaft-turbine. This engine is mounted in the fuselage nose and drives both main and tail rotors, each with four all-metal blades. The tail is hinged to fold for ease of stowage.

The Wessex has been ordered for service with the Royal Navy and will be used primarily for anti-submarine duties, carrying special search equipment and strike weapons. It will, however, be equally suitable for search and rescue, freight-carrying, casualty evacuation, training or communications. In addition to a



The Westland Wessex Naval Helicopter (1,430 s.h.p. Napier Gazelle turbine engine).

flight crew of two, with dual servo-operated controls, there will be accommodation for 12 passengers and baggage or eight stretchers. In the supply rôle, the Wessex will have internal capacity for 4,000 lb. (1,814 kg.) of freight at a concentration of up to 200 lb./sq. ft. (976.5 kg./m.^{2}) and an external sling load capacity of 4,000 lb. (1,814 kg.).

A prototype for the Wessex, using a Sikorsky S-58 airframe, but re-engined with a Napier Gazelle shaft-turbine, made its first flight on May 17, 1957.

The first Wessex prototype flew in 1958, and production aircraft are expected to be delivered in 1959. The Wessex will be available for civil use in due course.

Structural details are generally similar to those of the Sikorsky S-58, with the following exceptions :—

Rotor Drive.—Shaft drive to main rotor through double epicyclic reduction gear. Shaft drive to tail rotor through intermediate and tail gearboxes. Gas generator r.p.m. depends upon load conditions, but main rotor r.p.m. constant at 223, with tail rotor turning at 1,320 r.p.m.

Power Plant.—One Napier Gazelle NGa.13 shaft-turbine engine developing 1,430 s.h.p. (max. 1 hour) at S/L. and a max. continuous power of 1,200 s.h.p. Fuel tank under cabin floor. Oil capacity 5 Imp. gallons (22.7 litres).

Dimensions.—
Overall length 65 ft. 9½ in. (20.05 m.).
Overall length, tail folded 38 ft. 2 in. (11.63 m.).
Height to top of tail rotor 15 ft. 10 in. (4.82 m.).

Weights.—
Weight equipped 7,600 lb. (3,447 kg.).
Weight loaded 12,600 lb. (5,715 kg.).

Performance (estimated at 12,600 lb.=5,715 kg. A.U.W.).—
Max. speed at S/L over 138 m.p.h. (222 km.h.).
Cruising speed at S/L over 104 m.p.h. (167 km.h.).
Max. rate of climb at S/L. 1,650 ft./min. (503 m./min.).
Hovering ceiling without ground effect 5,000 ft. (1,525 m.).
Hovering ceiling with ground effect 7,000 ft. (2,135 m.).
Ceiling (cruising) 14,000 ft. (4,280 m.).
Range 390 miles (630 km.).

THE WESTLAND WESTMINSTER.

The name Westminster has been given to a new helicopter which is being developed by Westland as a private venture, using part of the main transmission, rotors and duplicated hydraulic control system of the Sikorsky S-56. Designed to meet a variety of civil and military rôles the Westminster will be capable of carrying 40 passengers and will have special freight-loading doors and hoisting facilities, with an external slinging point for loads that are too bulky to go inside its cabin.

Typical military loads will be 43 fully-equipped troops, or 31 stretcher cases, or four jeeps in an external sling.

The Westminster will be powered by two 2,800 s.h.p. Napier Eland N.El.5 shaft-drive turbines mounted above the forward portion of the cabin, immediately in front of the gearbox for the five-blade main rotor. The tail anti-torque rotor has four blades. Fuel capacity is 920 Imp. gallons (4,180 litres).

The passenger cabin will be 35 ft. long, 10 ft. wide and 6 ft. 6 in. high (10.67 × 3.05 × 1.98 m.), with a volume of 1,780 cub. ft. (50.4 m.^{3}). The rear freight compartment will have a capacity of 253 cub. ft. (7.16 m.^{3}).

As a first step, Westland has built a simple utility version of the Westminster, using a welded steel tube fuselage without skin and embodying the landing gear and the basic rotor and mechanical components of the ultimate complete power-plant and transmission system. This version is expected to have an application as a "flying crane" vehicle for civil and military operations where weight lifting is a prior consideration.



The utility version of the Westland Westminster Helicopter (two 2,800 s.h.p. Napier Eland turbine engines).



A model of the ultimate transport version of the Westland Westminster Helicopter.

The prototype of this utility version first flew on June 15, 1958.

DIMENSIONS.—
Diameter of main rotor 72 ft. (21.95 m.).
Diameter of tail rotor 15 ft. (4.57 m.).
Overall length 89 ft. 3 in. (27.3 m.).
Overall height at main rotor 18 ft. 4 in. (5.48 m.).
Overall height at tail rotor 22 ft. 0 ins. (6.79 m.).
Wheelbase 35 ft. 7 in. (10.85 m.).
Main wheel track 19 ft. 9 in. (6.05 m.).

WEIGHTS (Utility version).—
Weight empty equipped 21,300 lb. (9,670 kg.).
Disposable load 14,700 lb. (6,675 kg.).
Weight loaded 36,000 lb. (16,345 kg.).

WEIGHTS (Passenger transport).—
Weight empty 21,250 lb. (9,650 kg.).
Weight loaded 33,000 lb. (14,970 kg.).

PERFORMANCE (Utility version).—
Cruising speed 92 m.p.h. (147 km.h.).

PERFORMANCE (Passenger transport—estimated).—
Cruising speed at S/L. (70% M.E.T.O.) 150 m.p.h. (240 km.h.).
Rate of climb at S/L. over 2,000 ft./min. (610 m./min.).
Rate of climb at S/L. (one engine out) 600 ft./min. (183 m./min.).
Vertical rate of climb at S/L. 600 ft./min. (183 m./min.).
Range 400 miles (640 km.) with 3,800 lb. (1,725 kg.) payload.
Range 150 miles (240 km.) with 8,300 lb. (3,760 kg.) payload.

AUSTRALIA

COMMONWEALTH

COMMONWEALTH AIRCRAFT CORPORATION PTY., LTD.

HEAD OFFICE AND WORKS: LORIMER STREET, PORT MELBOURNE, VICTORIA.

Directors: Lieut. Gen. Sir Sydney Rowell, K.B.E., C.B. (Chairman), Essington Lewis, C.H., K. G. Begg, M. L. Baillieu, J. D. Bates, Wilfred Brookes, Sir Lawrence Wackett, D.F.C., A.F.C., B.Sc. (Manager), A. G. Brown (Secretary), L. Darling.

The Commonwealth Aircraft Corporation, Pty., Ltd., was formed in 1936 under a scheme propounded by the Australian Government for the establishment of an aircraft industry to make Australia independent of outside supplies.

The Corporation has an authorised capital of £2,000,000. The shareholders include the Broken Hill Proprietary Co. Ltd.; Broken Hill Associated Smelters Pty. Ltd.; Broken Hill South Ltd.; Electrolytic Zinc Co. of Australasia, Ltd; Imperial Chemical Industries of Australia and New Zealand, Ltd.; the Orient Steam Navigation Co. Ltd.; and Rolls-Royce Ltd.

Recent products of the Corporation are the CA-25 Winjeel three-seat basic trainer and the CA-27 Sabre fighter, both of which are in service in the Royal Australian Air Force, and the CA-28 Ceres agricultural aircraft.

The CA-27 Sabre was built under licence from North American Aircraft, Inc. It is powered by the Rolls-Royce Avon turbojet engine, which was also built at the Corporation's works at Fishermen's Bend.

THE COMMONWEALTH CA-28 CERES.

The Ceres is an agricultural aircraft built largely from components of the Wirraway trainer, a description of which has appeared in previous editions of "All the World's Aircraft." It is of conventional low-wing monoplane configuration, with a 600 h.p. Pratt & Whitney Wasp S1H1-G nine-cylinder radial air-cooled engine and non-retractable tail-wheel landing gear.

Special features of the agricultural conversion include a single-seat in a high-mounted enclosed cabin, a 40 cub. ft. (1.13 m.^{3}) stainless-steel hopper forward of the cabin, and the fitting of leading-edge slats and large manually-operated slotted flaps which are set half-down for normal top-dressing or spraying duties. The engine is arranged for direct airscrew drive and is uncowled. No electrical or hydraulic gear is fitted.

Two prototypes of the Ceres have been built and an initial production series of 40 is planned, following the release of large numbers of Wirraways by the R.A.A.F.

DIMENSIONS.—
Span 46 ft. 11 in. (14.30 m.).
Length 30 ft. 8½ in. (9.36 m.).
Height 9 ft. (2.74 m.).
Wing area 312 sq. ft. (29.0 m.^{2}).

WEIGHTS.—
Normal payload 2,000 lb. (907 kg.).
Max. payload 2,360 lb. (1,070 kg.).
Normal loaded weight 6,640 lb. (3,012 kg.).

PERFORMANCE.—
Ferrying speed at 4,950 lb. (2,245 kg.) A.U.W. 104 m.p.h. (167 km.h.).
Operating speed with 2,000 lb. (907 kg.) payload 92 m.p.h. (148 km.h.).
Stalling speed loaded 67 m.p.h. (107 km.h.).
Stalling speed empty 54 m.p.h. (87 km.h.).
Rate of climb with 2,000 lb. (907 kg.) payload 800 ft./min. (245 m./min.).
Take-off to 20 ft. (6 m.) with 2,000 lb. (907 kg.) payload 1,110 ft. (340 m.).
Landing distance, empty, from 50 ft. (15.25 m.) 1,170 ft. (355 m.).
Ferry range with 80 Imp. gallons (365 litres) fuel 518 miles (834 km.).

THE COMMONWEALTH CA-27 SABRE.

The Commonwealth Sabre, the prototype of which flew for the first time on August 3, 1953, is based on the North American F-86F and incorporates a considerable amount of local major re-design to allow it to be powered by the Rolls-Royce Avon engine of greater power and lighter installed weight. With the Avon consuming 25 per cent. more air than the J47, a much larger air inlet duct was necessary; and its lighter weight necessitated its re-positioning further aft in order to preserve the original C.G. positions. Structural re-design and the re-arrangement of internal equipment has resulted in only about 40 per cent. of the original fuselage structure being retained.

A heavier cannon armament has also been installed, and provision is made for the fitting of under-wing rockets and bombs.

The first production Avon-Sabre of a series of ninety was handed over to the R.A.A.F. on August 30, 1954. Production was completed in 1958.

TYPE.—Single-seat Fighter.

WINGS.—Low-wing cantilever monoplane with 35° sweepback. Thin laminar-flow wing section. All-metal structure of sandwich type construction in which the structural material is laminated between the inner and outer tapered skins. No ribs in inboard halves of wing panels and skin is milled from ½" material at roots. Fuel cells in centre-section and outboard wings. Auto slots on leading-edge. Slotted flaps. Irreversible power-operated aileron control system. Gross wing area 288 sq. ft. (26.8 m.^{2}).

FUSELAGE.—Oval section all-metal structure with flush-riveted stressed skin. Speed brakes near rear of fuselage.

TAIL UNIT.—Cantilever monoplane type. All-metal structure. All surfaces have 35° sweep-back. 10° dihedral tailplane. Tailplane and elevators controllable and linked for co-ordinated movement. Pitch control is irreversible and power-operated. Artificial sensing system to give pilot a representative feel in absence of air loads.

LANDING GEAR.—Retractable tricycle type with steerable nose-wheel. Hydraulic retraction. Cleveland air-oil shock struts. Extra high-pressure tyres. Bendix multiple-disc hydraulic brakes in cast magnesium main wheels. Track 8 ft. 4 in. (2.5 m.).

POWER PLANT.—One Rolls-Royce Avon 20 axial-flow turbojet with straight ram air entry in nose of fuselage. Nose entry lipped above to maintain adequate air-flow in nose-up position. Main fuel tanks in fuselage. External long-range drop tanks may be carried under wings outboard of landing gear.

ACCOMMODATION.—Pressurised pilot's cockpit with sliding bubble canopy. Pilot ejection seat.

ARMAMENT AND EQUIPMENT.—Two 30 mm. Aden cannon, and either two 1,000-lb. (454-kg.) bombs, or 24 × 3-inch rocket projectiles, or other offensive stores of equivalent weight.

DIMENSIONS.—
Span 37 ft. 1 in. (11.3 m.).
Length 37 ft. 6 in. (11.45 m.).
Height 14 ft. (4.27 m.).

WEIGHT.—
Weight loaded 15,800 lb. (7,173 kg.).

PERFORMANCE.—
Max. speed 700 m.p.h. (1,125 km.h.).
Landing speed 150 m.p.h. (240 km.h.).
Ceiling over 45,000 ft. (13,725 m.).
Range over 1,700 miles (2,720 km.).



Commonwealth CA-27 Sabre Single-seat Fighters of the Royal Australian Air Force.

THE COMMONWEALTH CA-25 WINJEEL.

The CA-25, which first flew on February 23, 1955, is the production version of the CA-22, the prototype Winjeel, which made its maiden flight in 1950. The name Winjeel comes from an aboriginal word meaning Eagle.

Production of 62 Winjeels for the R.A.A.F. was completed in 1958.

TYPE.—Three-seat Basic Trainer.

WINGS.—Low-wing cantilever monoplane. Wing section NACA 23015 at root tapering to NACA 23009 at tip, with negative twist of 2½°. Aspect ratio 6. Mean chord 6 ft. 5 in. (1.96 m.). Dihedral (outer wings 5°). Two-spar aluminium-alloy structure. All-metal electrically-operated trailing-edge flaps between ailerons, including section beneath fuselage. Frise type ailerons have metal frames and fabric covering. Total flap area 33.61 sq. ft. (3.12 m.²). Total aileron area 13.78 sq. ft. (1.28 m.²). Gross wing area 249 sq. ft. (23.13 m.²).

FUSELAGE.— Aluminium - alloy semi - monocoque structure.

TAIL UNIT.—Cantilever monoplane type. Metal frames with metal-covered fixed surfaces and fabric-covered rudder and elevators. Elevators have trailing-edge servo and trim tabs. Rudder has trim-tab only. Areas: fin 9.42 sq. ft. (0.88 m.²), rudder 9.25 sq. ft. (0.86 m.²), tailplane 46.5 sq. ft. (4.32 m.²), elevators 20.19 sq. ft. (1.88 m.²). Tailplane span 14 ft. (4.27 m.).

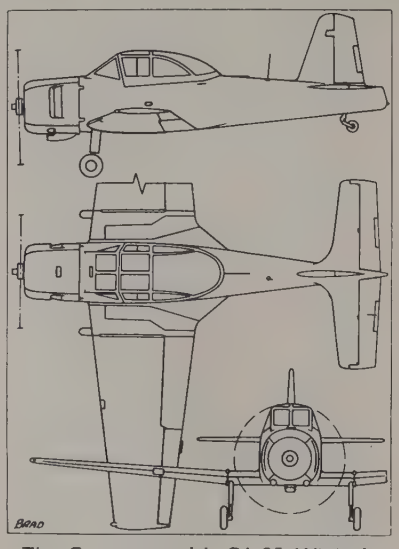
LANDING GEAR.—Fixed tail-wheel type. Cantilever long-stroke oleo-pneumatic shock-absorber struts. Dunlop wheels with hydraulic single-disc brakes. Free swivelling steerable tail-wheel. Track 10 ft. 1 in. (3.07 m.).

POWER PLANT.—One 445 h.p. Pratt & Whitney R-985-AN2 Wasp Junior nine-cylinder radial air-cooled engine on welded steel-tube mounting. Mounting attached to fireproof bulkhead by four bolts and quickly removable. Cowling in four opening panels hinged at the firewall for complete engine accessibility. Hamilton Standard two-blade variable-pitch airscrew. Two flexible bag tanks (34.5 Imp. gallons = 157 litres each) between spars in centre-section. Auxiliary fuselage tank may be carried beneath centre-section (30 Imp. gallons = 136 litres).

ACCOMMODATION.—Enclosed cockpit seats three, two side-by-side with dual controls in front plus third seat for additional pupil aft. Radio compartment beside rear seat. Sliding canopy may be jettisoned in emergency. Amber screening for blind flying training.



The Commonwealth CA-25 Winjeel (445 h.p. Pratt & Whitney R-985 engine).



The Commonwealth CA-25 Winjeel.

DIMENSIONS.—
Span 38 ft. 7½ in. (11.77 m.).
Length 28 ft. 0½ in. (8.55 m.).
Height 9ft. 1 in. (2.77 m.).

WEIGHTS AND LOADINGS.—
Weight empty 3,289 lb. (1,492 kg.).
Removable equipment 34 lb. (15 kg.).
Crew (2) 400 lb. (182 kg.).
Fuel (69 Imp. gallons) and oil (5 Imp. gallons) 542 lb. (246 kg.).
Weight loaded 4,265 lb. (1,935 kg.).
Wing loading 17.1 lb./sq. ft. (83.45 kg./m.²).
Power loading 9.58 lb./h.p. (4.34 kg./h.p.).

PERFORMANCE.—
Max. speed 186 m.p.h. (299 km.h.).
Cruising speed at 8,500 ft. (2,590 m.) 165 m.p.h. (265 km.h.).
Rate of climb at T.O. power 1,500 ft./min. (458 m./min.).
Rate of climb at rated power 1,130 ft./min. (344 m./min.).
Climb to 5,000 ft. (1,525 m.) at rated power 4.6 min.
Climb to 10,000 ft. (3,050 m.) at rated power 10 min.
Service ceiling 18,000 ft. (5,490 m.).
Stalling speed (flaps down) 53 m.p.h. (85 km.h.).
Stalling speed (flaps up) 62 m.p.h. (100 km.h.).
Take-off distance (standard temp.) 540 ft. (165 m.).
Take-off distance (tropical temp.) 630 ft. (192 m.).
Take-off distance to clear 50 ft. (15.25 m.) (standard temp.) 1,110 ft. (338 m.).
Take-off distance to clear 50 ft. (15.25 m.) (tropical temp.) 1,260 ft. (384 m.).
Landing distance from 50 ft. (15.25 m.) (standard temp.) 1,000 ft. (305 m.).
Cruising endurance (69 Imp. gal.) 3½ hours at 158 m.p.h. (253 km.h.) at 5,000 ft. (1,525 m.).

DE HAVILLAND

THE DE HAVILLAND AIRCRAFT COMPANY (PTY.), LTD.

HEAD OFFICE AND WORKS: MILPERRA ROAD, BANKSTOWN, N.S.W.

President: Sir Geoffrey de Havilland. Directors: A. Murray-Jones (Chairman), W. E. Nixon, Lester J. Brain (Managing Director), D. H. McLachlan (General Manager), J. J. Byrne and R. J. Vicars.

The de Havilland Aircraft Pty., Ltd. was formed in Australia in 1927 to act as agents for the de Havilland Aircraft Co., Ltd., to build de Havilland aircraft under licence, to assemble new aircraft and to operate service stations for de Havilland products throughout Australia.

The de Havilland Vampire T. Mk. 35 jet trainer is currently in production at Bankstown. This version differs from earlier Marks in having greater range and non-skid type brakes. Current orders are for a total of 68 Vampires for the R.A.A.F., of which the last is scheduled for delivery in April, 1960. The company is also overhauling and repairing R.A.A.F. Vampires and R.A.N. Sea Venoms.

Just as these pages were being closed for press it was learned that de Havilland is taking over the management of the Government Aero-Engine Factory at Lidcombe, N.S.W., and that it will transfer there all work being done at the Government-owned and D.H.-managed propeller factory at Alexandria, N.S.W. D.H. will also transfer its engine overhaul shops, which look after the Goblin and Ghost engines for the R.A.A.F. and R.A.N. respectively, from Bankstown to Lidcombe.

The Company's guided weapons activities are being handled at a facility at Salisbury, N.S.W.

FAIREY

FAIREY AVIATION COMPANY OF AUSTRALASIA PTY. LTD.

REGISTERED OFFICE: 16, O'CONNELL STREET, SYDNEY, N.S.W.

WORKS: AIRPORT, BANKSTOWN, N.S.W.

POSTAL ADDRESS: P.O. Box 41, BANKSTOWN, N.S.W.

Chairman and Managing Director: Raymond E. Purves.

Secretary and Finance Manager: J. R. Sainsbury.

Production Manager: F. O. Walker.

Chief Engineer: R. A. Manuel.

This Company was founded in 1948 under the name of Fairey Clyde Aviation Co. Pty. Ltd. In November, 1951 the name was changed to Fairey Aviation Company of Australasia Pty. Ltd.

The Bankstown Works has carried out modifications, repairs and reconditioning of Fairey Firefly and Hawker Sea Fury aircraft of the Royal Australian Navy, and of Meteor T. Mk. 7 and F. Mk. 8 aircraft for the Royal Australian Air Force. Since 1956, the Company has been engaged on similar work on the Fairey Gannet A.S. Mk. 1 for the Royal Australian Navy.

In addition, overhaul of DC-3 and Dakota aircraft and components is in hand for Australian airlines, and agricultural conversion design and installations are being undertaken for Australian and New Zealand operators.

The Company is approved by both the Department of Defence Production and the Department of Civil Aviation for design and for all classes of aircraft repair and manufacture.

The Special Projects Division is located at Salisbury, South Australia, with Colonel R. T. Elvish as General Manager. This Division is engaged on work in connection with the activities of the Rocket Range at Woomera, South Australia.

GOVERNMENT FACTORIES

DEPARTMENT OF DEFENCE PRODUCTION, DIVISION OF AIRCRAFT PRODUCTION.

Head Office: 8th Floor, 339 Swanston Street, Melbourne, Victoria.

Assistant Secretary (Aircraft Production): S. C. Weetman.

General Manager (Aircraft and Guided Weapons Supply): I. B. Fleming.

Aircraft Factories: Fishermen's Bend (Headquarters), Melbourne, Victoria.

Airfield and Final Assembly Workshops: Avalon, Victoria.

Manager: N. W. Hodgson.

Maintenance Branch: Fairfield, Melbourne, Victoria, and Parafield, South Australia.

Manager: M. A. W. Forestier.

Heavy Forge Annexe: Granville, New South Wales.

Managed by Australian Aluminium Company Pty. Ltd.

In current production is the Canberra B. Mk. 20 which is built under licence from the English Electric Co., Ltd., the Jindivik target drone which was designed and developed at the Government Aircraft Factories; and the Malkara anti-tank missile.

Work is also in progress to convert five Canberra Mk. 20 and two Mk. 2 (British) bombers to a trainer version to be known as the Canberra T. Mk. 21.

An order for ten Jindiviks and associated ground equipment from the Royal Swedish Air Board was completed in 1957. Current production includes more than 150 for the British Government.

In the interests of economy, the Division of Aircraft Production is understood to be disposing of its Aero-Engine Factory at Lidcombe, N.S.W. (to de Havilland) and its Propeller Annexe at Alexandria, N.S.W. which, when the present activities (managed by de Havilland) have been transferred to Lidcombe, will be sold.

THE JINDIVIK Mk. 1.

The Jindivik Mk. 1 was designed to Specification E.7/48 issued by the British Ministry of Supply as a high-speed pilotless target aircraft for use in guided weapon development programmes. Mk. 1 was powered by an Armstrong Siddeley Adder ASA.1 turbojet engine. It first flew in August, 1952, and remained in production until 1954, when it was superseded by the Mk. 2. A full description of the Mk. 1 has appeared in earlier editions of "All the World's Aircraft."

THE JINDIVIK Mk. 2 and 3.

This version is similar in layout to the Mk. 1 but the aerodynamic features have been revised to take full advantage of the greater thrust provided by the Viper engine. At the same time, the structure has been simplified and Araldite bonding methods introduced on many major assemblies.

It is available in four forms :—

Mk. 2. Basic type, as described below.

Mk. 2A. Similar to Mk. 2, but with extended wing-tips, modified air intake, improved cameras and ceiling of 52,000 ft. (15,850 m.).

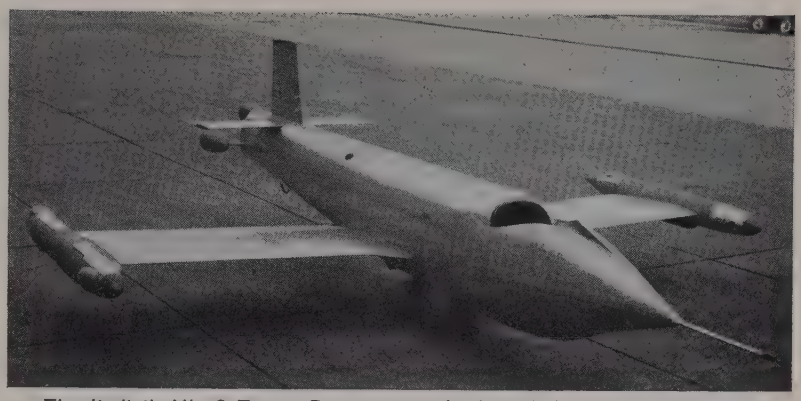
Mk. 2B. Similar to Mk. 2A, but with Viper ASV.8 turbojet (1,750 lb.=795 kg. s.t.).

Mk. 3. Similar to Mk. 2A, but with Viper ASV.11 turbojet (2,460 lb.=1,116 kg. s.t.) and ceiling of at least 60,000 ft. (18,300 m.).

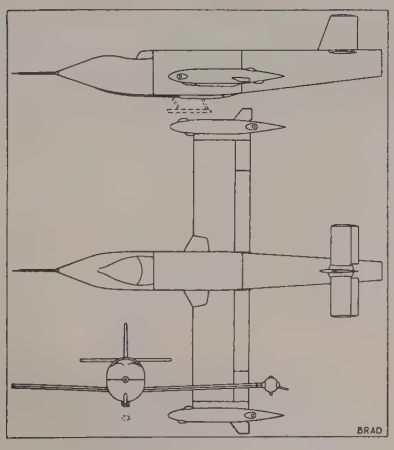
The first prototype of the Mk. 2 made its first test flight on December 11, 1953, and the following details apply to this version :—

Type.—Target Drone.

Wings.—Mid-wing cantilever monoplane. Wing section NACA 64 Series with constant thickness-chord ratio of 6% and cambered to C.L. of 0.1. Aspect ratio 4.75. Structure consists of constant-section four-spar box adhesive-bonded to form an integral fuel tank. A light-skinned leading-edge is stabilised with paper honeycomb and the two-spar trailing-edge structure carries the ailerons and flaps on a continuous piano hinge. Ailerons operated by electric servo-motor. Flaps, which also serve as air brakes, are operated pneumatically. Total flap area 11.5 sq. ft. (1.07 m.²). Total aileron area 4.5 sq. ft. (.42 m.²). Gross wing area 76 sq. ft. (7.06 m.²).



The Jindivik Mk. 2 Target Drone on its landing skid. Note the wing-tip camera pods.



The Jindivik Mk. 2 Target Drone.

Fuselage.—Of light alloy in four main sections, front fuselage, equipment bay canopy, centre fuselage and rear fuselage. Front fuselage carries all automatic control equipment on three removable trays. Canopy, which lifts off for access, also forms the NACA submerged air-intake. Centre fuselage contains a bay for special equipment and the main fuel tank of the crash-proof rubber bag type, the air intake passes. Rear fuselage carries the engine and jet-pipe.

Tail Unit.—Cantilever monoplane type. Multi-spar tailplane of light alloy bonded with Araldite. Elevators formed of single wrapped skins stiffened by chordwise flutes and carried on continuous piano hinges bonded to tailplane. Fin consists of light skin bonded to two spars and stabilised by paper honeycomb filling. There is no rudder. Areas: fin 6.52 sq. ft. (0.61 m.²), tailplane 10.28 sq. ft. (0.95 m.²). Tailplane span 6 ft. 6 in. (1.98 m.).

Power Plant.—One Armstrong Siddeley Viper ASV.3 short life turbojet engine mounted in rear fuselage. An extractor duct surrounds the jet pipe, drawing cooling air through four flush intakes around engine combustion chamber. Engine air intake is an NACA submerged type on top of the fuselage nose. Main fuselage fuel tank has capacity of 63 gallons (286 litres) and integral wing tanks have total capacity of 32 gallons (146 litres). Wing tanks are pressurised from engine compressor to feed fuselage tank from where it is pumped to the engine. Compressed air is used for starting and throttle is operated by electric actuator.

Electrical System.—Power for electrical services is drawn from an engine driven 6KW. D.C. generator with a regulated output of 27.5 volts. Generator supplies all requirements with relatively low capacity accumulators floating in the circuit. All main circuits are protected by auto resetting circuit breakers.

Remote-Control Equipment.—Control can be achieved from either a ground or airborne controlling station. Equipment consists briefly of a radio control receiver, units for interpreting external signals and applying them to control the aircraft, automatic pilot, and a telemetry transmitter for passing essential control information back to ground. Notch aerials in fin leading-edge for radio receiver and telemetry transmitter.

Recording Equipment.—Cameras fitted with wide-angle lenses may be mounted in pods on each wing-tip and are used to film the approach and proximity of missiles fired against the target.

Take-off and Landing.—For take-off the aircraft is mounted on three collapsible arms on tubular-framed trolley with a tricycle wheeel configuration. The nose wheel is steered by a servo motor governed by a directional gyro. The aircraft accelerates under normal jet power and is automatically released at 110 knots (126.6 m.p.h.=202.5 km.h.) and the trolley is halted by brakes on rear wheels. When aircraft has accelerated to 130 knots (149.7 m.p.h.=239.5 km.h.), flaps are automatically retracted and aircraft sets itself in climbing attitude. At take-off central landing-skid is retracted in fuselage. When "undercarriage down" radio sequal is sent skid is automatically extended and charged from pneumatic system. At same time flaps are lowered to 20° landing setting and an auxiliary "sting" is lowered from landing skid. On touch-down "sting" functions to cut engine fuel supply and to energise release unit in flap jack to return flaps to streamline to prevent aircraft from floating on rebounding.

Dimensions.—
Span (without wing-tip pods) 19 ft. (5.79 m.).
Span (with wing-tip pods) 23 ft. 7 in. (7.2 m.).
Length overall 23 ft. 3¾ in. (7.11 m.).
Height (static on skid to top of fin) 6 ft. 3½ in. (1.92 m.).

Weights.—
Structure 791 lb. (359 kg.).
Power plant 516 lb. (234 kg.).
Fixed services 169 lb. (77 kg.).
Remote control and navigation equipment 273 lb. (124 kg.).
Special trials equipment 373 lb. (169 kg.).
Fuel and oil 778 lb. (353 kg.).
All-up weight 2,900 lb. (1,317 kg.).

Performance (less wing-tip pods, at 2,540 lb. = 1,153 kg.).—
Max. speed 564.2 m.p.h. (902.7 km.h.) at 37,000 ft. (11,285 m.).
Rate of climb at S/L 8,000 ft./min. (2,440 m./min.).
Service ceiling (500 ft. (150 m.)/min.) 50,000 ft. (15,250 m.).
Time to 40,000 ft. (12,200 m.) 9.4 min.
Endurance (incl. 10 min. at max. speed at service ceiling and with full climb, descent and landing allowances) 58 min.

Performance (with wing-tip pods, at 2,600 lb.=1,180 kg.).—
Max. speed 570 m.p.h. (912 km.h.) at 38,500 ft. (11,740 m.).
Rate of climb at S/L 8,000 ft./min. (2,440 m./min.).
Service ceiling above 50,000 ft. (15,250 m.).
Time to 40,000 ft. (12,200 m.) 9.8 min.
Endurance (with full allowances as above) 60 min.

KINGSFORD SMITH

KINGSFORD SMITH AVIATION SERVICE PTY., LIMITED.

HEAD OFFICE AND WORKS: BANKSTOWN AERODROME, BANKSTOWN, SYDNEY.

Directors: J. T. Brown, A.F.R.Ae.S., A.M.I.Mech.E. (Managing), P. G. Brown, D.F.C. and J. E. Smith.

Chief Designer: L. Pellarini.

Kingsford Smith Aviation Service was formed in 1946 from the original Kingsford Smith Air Service which was built up in 1935 by Sir Charles Kingsford Smith. Since the War, the company has been actively concerned with the sales, service and overhaul of light and medium aircraft, and the development of light aircraft for Australia's outback conditions.

Early in 1955, the company embarked upon the prototype production of a design to meet the requirements of operators in Australia and New Zealand for a medium-sized agricultural aircraft.

The prototype of this aircraft, which was designated the PL-7, first flew on September 21, 1956. It has been described in previous editions of this Annual. The company has now produced in prototype form the K.S.3 Cropmaster, brief details of which follow.

THE KINGSFORD SMITH KS-3 CROPMASTER.

A prototype of the KS.3 Cropmaster agricultural aircraft has been built. It is a conventional low-wing monoplane with a tail-wheel landing gear and powered by a 170 h.p. Warner Super Scarab radial engine. Wing areas is 190 sq. ft. (17.6 $m.^2$), including the high-lift flaps.

Few performance details were available at the time of writing, except that the Cropmaster has an operating speed of 98 m.p.h. (158 km.h.), carrying a pilot and 896 lb. (406 kg.) of dust or 80 Imp. gallons (365 litres) of spray.

MOLYNEUX

THE MOLYNEUX HELICOPTER CO., PTY., LTD.

HEAD OFFICE AND WORKS: MELBOURNE AIRPORT, VICTORIA.

Directors: G. C. Molyneux B.E., A.F.R.Ae.S., M.I.Ae.S., A.M.I.E. (Australia) and P. M. Molyneux.

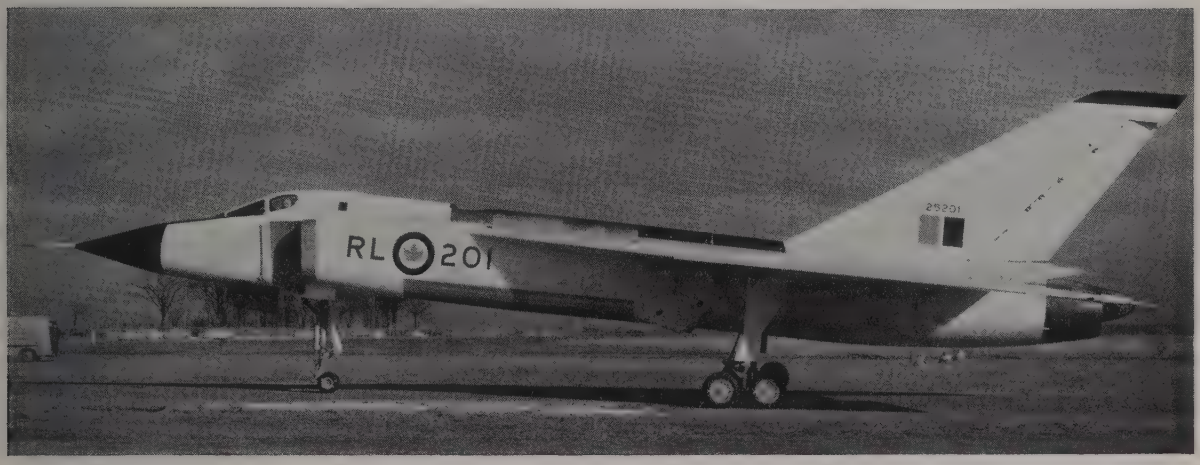
This company was formed in November, 1953, with an authorised capital of £100,000, to design and develop a tandem-rotor helicopter, with particular attention to a rotor head design which will eliminate severe oscillation in the plane of rotor rotation when the tip path plane is tilted in relation to the shaft. This rotor head is now patented.

Development work is being carried out in conjunction with the Aeronautical Research Laboratories of the Australian Department of Supply, which is undertaking all stress calculations, structural tests and wind-tunnel tests on dynamic models. The dynamic tests consist of flying powered scale models supported on universal joints in the wind-tunnel to check the mechanical functioning of the unique and patented rotor head and to determine the thrust, speed, rate of climb, power required, etc.

The Aeronautical Research Laboratories have also undertaken to do the ground testing and the first 25 hours of flight testing of the full-size prototype, but this cannot be done until all the above testing has been completed. It is, however, expected that flight testing of the full-size prototype will begin about the end of 1958.

CANADA

AVRO



The Avro Arrow Mk. I Two-seat All-weather Interceptor (two Pratt & Whitney J75 turbojet engines).

AVRO AIRCRAFT LIMITED.

HEAD OFFICE AND WORKS: MALTON NEAR TORONTO, ONT.

POST OFFICE ADDRESS: BOX 4004, TERMINAL "A", TORONTO, ONT.

Chairman and President: F. T. Smye.

Executive Vice-President and General Manager: J. L. Plant.

Vice-President—Engineering: J. C. Floyd.

Vice-President—Sales and Service: J. A. Morley.

Vice-President — Finance: J. Turner.

Works Manager: W. H. Riggs.

A. V. Roe Canada Ltd., is one of four companies forming the Aeronautical Division of A. V. Roe Canada, Ltd., a member of the Hawker Siddeley Group. In 1945 A. V. Roe Canada took over the Malton plant of the Government-owned Victory Aircraft, Ltd., and this Malton organisation eventually expanded into two divisions, one concentrating on airframes and the other on gas-turbine engines.

To meet the growing complexities and divergent airframe and aero-engine demands the two divisions were incorporated as separate companies with A. V. Roe Canada, Ltd., as the parent corporation.

The Aircraft Division has been operating as a separate corporate entity under the name of Avro Aircraft, Ltd. since January 2, 1955.

Currently in production is the CF.100 twin-jet long-range all-weather fighter, which is now in R.C.A.F. squadron service throughout Canada. Four squadrons of CF.100 Mk. 4B's are also serving with the R.C.A.F. in Europe to meet a specific N.A.T.O. requirement for night fighters. The first group of a total of 53 CF-100 Mk. 5's ordered by the Belgian Air Force had been delivered before the end of 1957.

Currently under development is the Arrow supersonic delta-wing all-weather bomber destroyer, details of which follow.

THE AVRO ARROW.

R.C.A.F. designation: CF-105.

The Avro Arrow has been designed as a supersonic interceptor capable of combatting manned bombers which might be expected to exist in about five years time from now.

Two versions of the Arrow have been announced :—

Arrow Mk. 1. First five aircraft, each powered by two Pratt & Whitney J75 turbojet engines with afterburners.

Arrow Mk. 2. Developed version with two Orenda Iroquois turbojet engines.

The first Arrow Mk. 1 flew for the first time on March 25, 1958 and all five Mk. 1 aircraft had been completed by the Summer of 1958. They will be followed by an initial series of 32 Mk. 2 aircraft. The second Mk. 1 has achieved a speed of 1,200 m.p.h. (1,930 km.h.) in level flight and has climbed at supersonic speed.

The following details refer specifically to the Mk. 1, but are generally applicable to the Mk. 2 also.

TYPE.—Two-seat All-weather interceptor.

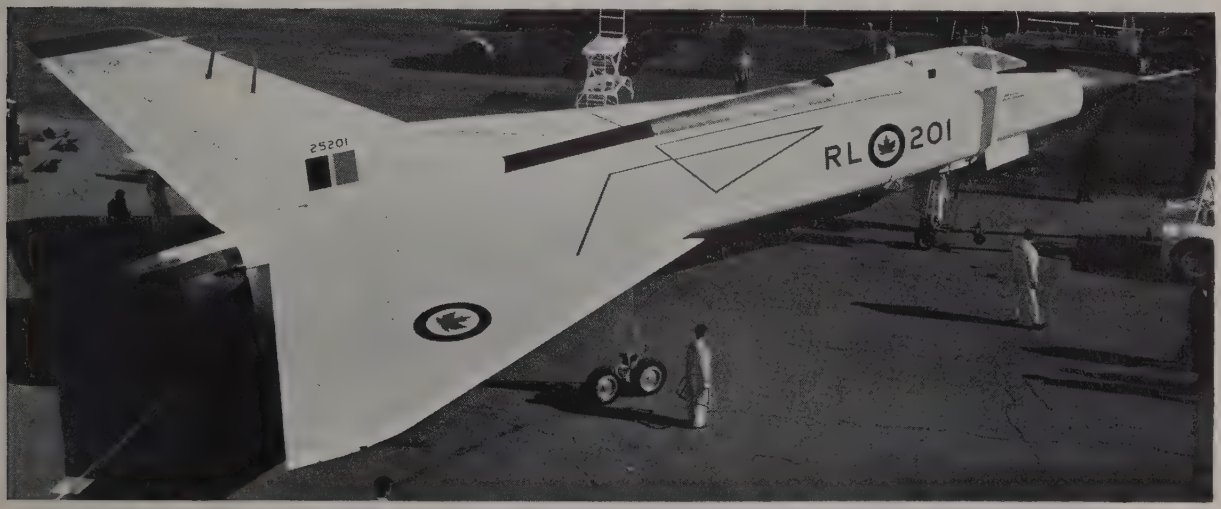
WINGS.—Shoulder-wing cantilever monoplane of delta planform. Sweepback 61° on inner wings, 63° 30′ outboard of fence and "dog-tooth" leading-edge. Chord at root more than 35 ft. 6 in. (11.2 m.). All-metal multi-spar structure, with large integrally-stiffened skin panels. Conical camber on leading-edges. Fully-powered aileron and elevator on each wing trailing-edge. Estimated areas: ailerons (total) 88 sq. ft. (8.18 m.²), elevators (total) 146 sq. ft. (13.56 m.²), wings (gross) 1,550 sq. ft. (144 m.²).

FUSELAGE.—All-metal structure of basically-rectangular section, with pointed dielectric nose-cone. Two door-type air-brakes under centre-fuselage. Braking parachute in tail fairing.

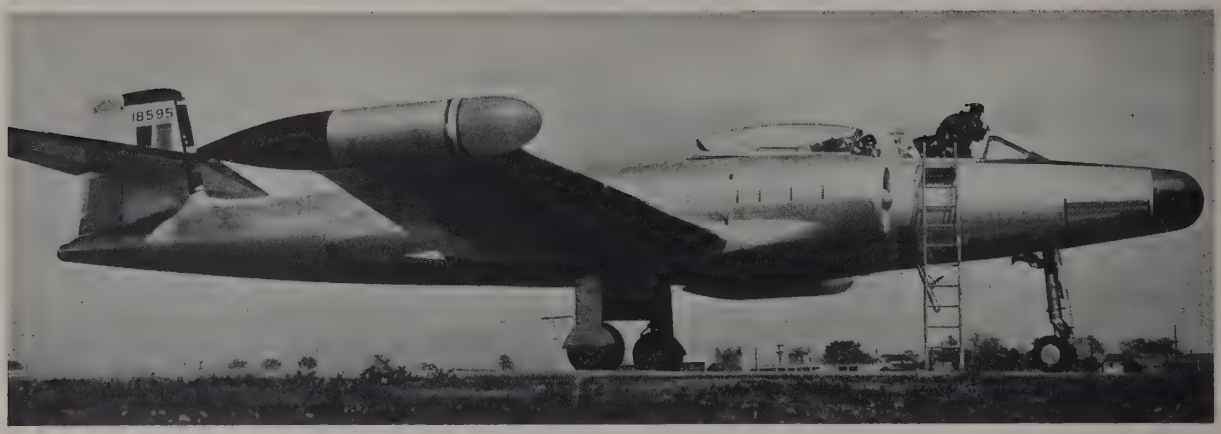
TAIL UNIT.—Cantilever fin and rudder only. All-metal structure. Estimated areas: fin 145 sq. ft. (13.47 m.²), rudder 48 sq. ft. (4.46 m.²).

LANDING GEAR.—Retractable tricycle type, with main units of Dowty (Canada) design and nose unit by Jarry Hydraulics. Hydraulic retraction. Dowty liquid-spring oleo-pneumatic shock-absorbers. Each main unit has two Goodyear wheels in tandem and Goodyear hydraulic brakes. Nose unit has twin Dunlop wheels and tyres, with hydraulic steering. Wheel track 25 ft. 5½ in. (7.76 m.). Wheelbase 30 ft. 1 in. (9.17 m.).

POWER PLANT (Mk. 1).—Two Pratt & Whitney J75 turbojets with afterburners, mounted side-by-side in fuselage. Fuel in integral tanks in wings.



The Avro Arrow Mk. I two-seat All-weather Interceptor (two Pratt & Whitney J75 turbojet engines).



The Avro CF.100 Mk. 5 Two-seat All-weather Fighter (two Orenda 11 turbojet engines).

ACCOMMODATION.—Pilot and navigator in tandem on Martin-Baker Mk. 4 ejection seats in pressurised cockpits. Each canopy consists of two separate downward-hinging panels which lock on aircraft centre-line.

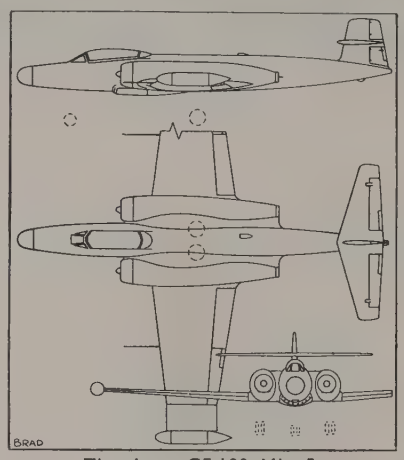
ARMAMENT.—Sparrow II guided air-to-air missiles carried in very large under-fuselage weapons bay. Astra automatic flight, navigation, fire control and communications system by R.C.A. and Minneapolis-Honeywell.

DIMENSIONS.—
Span 50 ft. (15.25 m.).
Length 78 ft. (23.79 m.).
Height 21 ft. 3 in. (6.48 m.).

THE AVRO CF.100.

The CF.100 two-seat long-range all-weather fighter, which was designed to the requirements of the Royal Canadian Air Force, was the first aircraft to be wholly designed and built in Canada. By exceeding Mach 1 in a dive from 30,000 ft. (9,150 m.) on December 18, 1952, the CF.100 achieved the distinction of being the first straight-wing combat aircraft to exceed the speed of sound. Supplied to the Royal Canadian Air Force and the Belgian Air Force (50 aircraft), but production due to be phased out by the end of 1958. More than 700 will have been built.

Some CF.100's have been equipped for "collision course" target towing. The towing hook is contained in an extended tail-cone, and they have an all-over coat of luminous red paint as a safety precaution.



The Avro CF.100 Mk. 5.

The following are the principal versions of the CF.100 :—

Mark 1. Two Rolls-Royce Avon turbojet engines. Two prototypes built. First Mk. 1 flew for the first time on January 19, 1950.

Mark 2. Two Orenda turbojet engines. Pre-production unarmed model. Ten built. First Mk. 2 flew on June 20, 1951. One Mk. 2T with dual controls.

Mark 3. Two Orenda 9 turbojet engines. First production series. Seventy built. Armament: eight 0.50 in. (12.7 mm.) machine-guns in easily-replaceable ventral tray. First Mk. 3 flew on October 11, 1952. Fifty converted into dual-control trainers under designations Mk. 3CT and Mk. 3D.

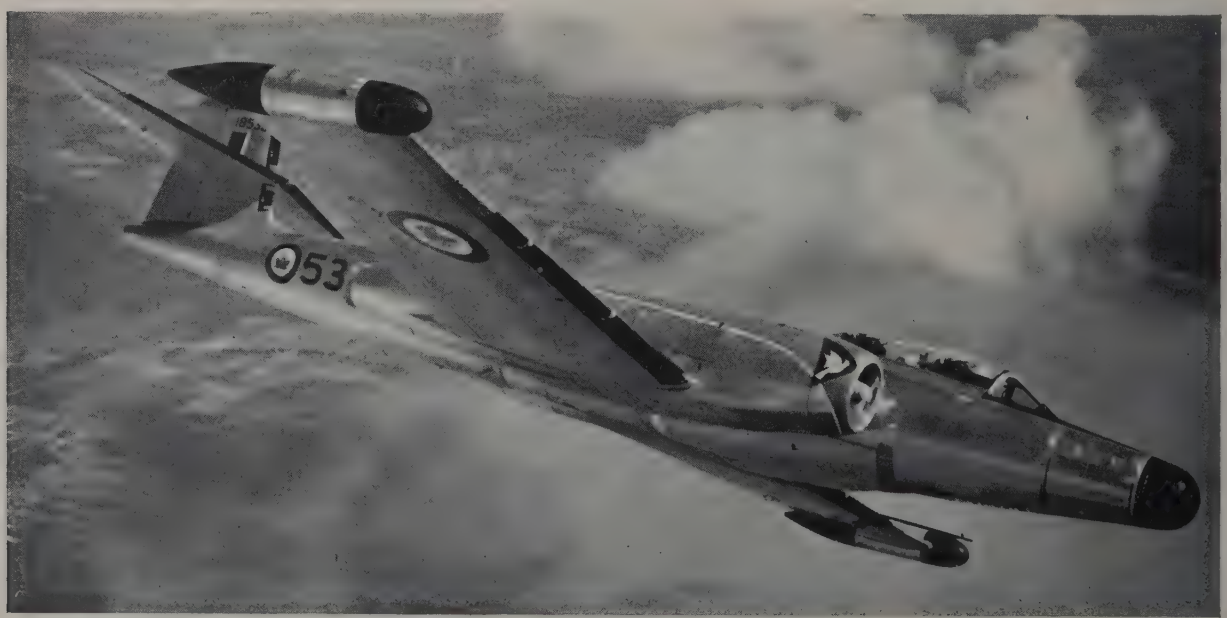
Mark 4. Two Orenda 9 (Mk. 4A) or Orenda 11 (Mk. 4B) turbojet engines. Longer fuselage and revised nose shape. Armament consists of both 0.50 in. (12.7 mm.) machine-guns and rockets. Rocket armament carried in wing-tip containers. Hughes MG-2 fire control system. Increased performance. Prototype Mk. 4 flew on October 11, 1952, and the first production Mk. 4 on October 24, 1953.

Mark 5. Two Orenda 11 turbojet engines. Development of Mk. 4 with additional wing and tailplane area for improved performance at high altitude. Fuselage gun-pack deleted. First production Mk. 5 flew on October 12, 1955. Two modified Mk. 5's are being used for Sparrow II air-to-air missile research and test firings for the Avro Arrow.

The description which follows refers in the main to the CF.100 Mk. 5.

TYPE.—Two-seat Long-range All-weather Fighter.

WINGS.—Low-wing cantilever monoplane. Wing section NACA 0010. Aspect ratio 5.9. Chord at root 13 ft. 11 in. (4.24 m.), at tip 7 ft. 2½ in. (2.20 m.). Dihedral at datum 3°. Sweepback 5.69° on leading-edge. All-metal structure with split flaps on centre-section and plain flaps on outer wings. Total aileron area (including tabs) 28.6 sq. ft. (2.65 m.²). Total area of flaps 65.7 sq.



The Avro CF.100 Mk. 5 Two-seat All-weather Fighter (two Orenda 11 turbojet engines).

ft. (6.10 m.²). Dive-brake area (total of four) 41.76 sq. ft. (3.88 m.²). Gross wing area 591 sq. ft. (54.91 m.²).

FUSELAGE.—All-metal flush-riveted semi-monocoque structure.

TAIL UNIT.—Cantilever monoplane type. Tailplane mounted halfway up fin. All-metal structure. Areas: fin 35.3 sq. ft. (3.28 m.²), rudder 11.62 sq. ft. (1.08 m.²), elevator 27.15 sq. ft. (2.52 m.²), tailplane 98.4 sq. ft. (9.14 m.²). Tailplane span 25 ft. (7.62 m.).

LANDING GEAR.—Retractable tricycle type. Hydraulic retraction. Dowty liquid-spring shock-absorber struts. Dunlop wheels and Dunlop brakes on main wheels. Track 10 ft. 2 in. (3.10 m.). Wheelbase 18 ft. 1½ in. (5.52 m.).

POWER PLANT.—Two Orenda Series 11 axial-flow turbojet engines (over 7,000 lb. = 3,180 kg. s.t. each).

ACCOMMODATION.—Pressurised cockpit seating two in tandem, pilot in front, navigator/radar-operator behind. Sliding jettisonable canopy. Martin Baker ejection seats for both members of crew.

DIMENSIONS.—
Span 60 ft. 10 in. (18.54 m.) over rocket pods.
Length 54 ft. 2 in. (16.5 m.).
Height 14 ft. 6 in. (4.42 m.).

WEIGHTS.—
Weight loaded approx. 33,600 lb. (15,240 kg.).

PERFORMANCE.—
No data available.

BRISTOL

THE BRISTOL AEROPLANE COMPANY OF CANADA, LTD.

HEAD OFFICE: 200 INTERNATIONAL AVIATION BUILDING, MONTREAL 3, QUEBEC.

Directors: Sir Reginald Verdon Smith (Chairman); R. J. Reynolds (President); P. P. Hutchison, Q.C.; J. N. Baird; Air Cdre. F. R. Banks, C.B., O.B.E.; R. G. B. Dickson, Q.C.; W. S. Haggett; W. R. C. Patrick; Air Vice-Marshal A. L. James.

Vice-President and Secretary: B. A. Chalmers.

Treasurer: R. G. Small.

The Bristol Aeroplane Company of Canada Ltd., is a wholly-owned subsidiary of The Bristol Aeroplane Company Ltd. of England. The Company operates as a head office for a group of four subsidiaries: Bristol Aero Engines Ltd., in Montreal North, Bristol Aero Engines (Western) Ltd. in Vancouver, Bristol de Mexico, S.A., in Mexico City—all of which are engaged in the repair and overhaul of aero-engines—and Bristol Aircraft (Western) Ltd., an aircraft inspection and repair plant, also engaged in the manufacture of aircraft and jet engine components.

In addition to functioning as a central management organisation for these enterprises, the Canadian parent company is available to inform North American aviation of the resources and products of the parent company in England, and is responsible for all public relations and advertising.

BRISTOL AIRCRAFT (WESTERN) LTD.

HEAD OFFICE AND WORKS: STEVENSON FIELD, P.O. BOX 874, WINNIPEG, MANITOBA.

Directors: R. J. Reynolds (Chairman); W. S. Haggett (President); B. A. Chalmers (Vice-President); W. M. Auld (General Manager); Sir Reginald Verdon Smith; G. Lawson, R. G. B. Dickson.

Secretary-Treasurer: G. W. Band.

This Company assumed the ownership of McDonald Brothers Aircraft of Winnipeg in 1954. The largest of Bristol interests in North America, it occupies an area of 425,000 sq. ft. and is involved in a wide range of activities, including the repair, overhaul and modification of R.C.A.F. Expeditor, Mitchell and CF-100 aircraft. Components for aircraft and jet engines are also manufactured at this plant, together with floats for land-based and amphibious aeroplanes. A total of 1,250 persons was employed at the beginning of 1958.

CANADAIR

CANADAIR LIMITED.

HEAD OFFICE AND WORKS: CARTIERVILLE AIRPORT, MONTREAL, P.Q.

POSTAL ADDRESS: P.O. BOX 6087, MONTREAL, P.Q.

Chairman of the Board: Frank Pace, Jr.

President and General Manager: J. Geoffrey Notman.

Vice-Chairmen of the Board: Earl D. Johnson and Lawrence B. Richardson.

Vice-President and General Counsel: John E. L. Duquet, Q.C.

Vice-President—Engineering: William K. Ebel.

Assistant to the President: Curtis F. Fincham.

Assistant to the Chairman of the Board—Finance: Lambert J. Gross.

Assistant to the Chairman of the Board—Legal Affairs: Roger I. Harris.

Vice-President and Comptroller: Frederick R. Kearns.

Assistant to the Chairman of the Board—Planning: Allen D. Marshall.

Vice-President—Sales: Peter H. Redpath.

Vice-President—Manufacturing: Dean P. Stowell.

Director of Public Relations: Gordon J. Stringer.

Secretary and Treasurer: John Urwin.

Assistant to the Chairman of the Board—Communication: Vernon M. Welsh.

Canadair, a subsidiary of General Dynamics Corporation of New York, originated from the pioneer aircraft design and manufacturing company in Canada, Canadian Vickers Limited. It was acquired by General Dynamics in 1946, and is now engaged on the development and production of aircraft, guided missiles and nuclear engineering products.

The company's Aircraft Manufacturing Division is continuing production of CL-28 Argus maritime reconnaissance aircraft and CL-44 turboprop long-range transports for the R.C.A.F. Deliveries of the Argus began in September, 1957, and the first CL-44 is scheduled for delivery in the Autumn of 1959.

Also in production for the R.C.A.F. is the Canadair-540, a turboprop development of the Convair 240, 340 and 440 series, and the first aircraft of this type is due to fly in May, 1959. Production of the Canadair T-33 Silver Star, a version of the Lockheed T-33 advanced jet trainer, will phase out in January, 1959.

The Canadair Sabre 6 went out of production with completion of an order for 225 for the West German Air Force; but a new version, the Sabre missile-armed high-altitude interceptor, is projected. Also under development is the CL-41 side-by-side jet-powered basic trainer, with the first of two prototypes scheduled to fly early in 1959.

Canadair's Missile Division has been appointed co-ordinating contractor for the Sparrow II air-to-air guided weapon programme by the Canadian Department of Defence Production and the R.C.A.F. Details of this work are given in the "Guided Missiles" section of this work.

A natural uranium, heavy water-sub-critical reactor built by the company's Nuclear Division is now in operation at the University of Toronto. Other research, design and development programmes in this field are under way.

Canadair's plant at Cartierville Airport has a covered floor area of 2,750,000 sq. ft. and new extensions are in the planning stage. Approximately 10,500 persons were employed there at the end of 1958. In addition, there is a South American subsidiary known as Canadair International Ltd., at Bogota, Colombia.

THE CANADAIR CL-66 (CANADAIR 540). R.C.A.F. designation: CC-109.

The Canadair CL-66, which is being marketed as the Canadair 540, is a development of the Convair 440 Metropolitan with two Napier Eland turboprop engines instead of the original Pratt & Whitney R-2800 piston-engines. It is being built on jigs and tools which were transferred to Canadair's Montreal factory from the Convair works at San Diego when production of the Metropolitan was phased out to make room for Convair 880 jet transport assembly lines. As a result, it was hoped to have the first Canadiar 540 ready for flight testing by May, 1959.

Two basic versions of the Canadair 540 are offered initially, as follows:—

CL-66A. Passenger transport with accommodation for 48 persons.

CL-66B. All-cargo version with reinforced floor, 10 ft. (3.50 m.) wide loading door and capacity payload of 14,300 lb. (6,486 kg.).

Mixed passenger/freight, convertible and executive versions are available. In addition both Canadair and D. Napier & Son of Acton, England, makers of the Eland turboprop, are offering a conversion programme to enable operators of existing Convair 340 and 440 aircraft to change to turboprop power.

First contract for the Canadair 540 has come from the Canadian Government, which has ordered 10 CL-66B's for the R.C.A.F. Air Transport Command, under the designation of CC-109.

The Canadair 540 is structurally identical to the Convair 440 Metropolitan, except for its power plant. This consists of two 3,360 e.s.h.p. Napier Eland NE1.6 Mk. 503 turboprops, driving de Havilland metal four-blade constant-speed feathering airscrews with a diameter of 13 ft. 6 in. (4.11 m.). Its total fuel capacity is 1,735 Imp. gallons (7,887 litres).

DIMENSIONS.—
Span 105 ft. 4 in. (32.12 m.).
Length 81 ft. 6 in. (24.84 m.).
Height 28 ft. 1 in. (8.56 m.).

WEIGHTS.—
Take-off weight 53,200 lb. (24,130 kg.).
Landing weight 50,670 lb. (22,985 kg.).
Zero fuel weight 47,000 lb. (21,320 kg.).

PERFORMANCE (estimated).—
Cruising speed 326 m.p.h. (525 km.h.).
Stalling speed 89 m.p.h. (143 km.h.).
Range 1,585 miles (2,550 km.).

THE CANADAIR CL-44D. R.C.A.F. designation: CC-106.

The CL-44D transport is a derivative of the CL-28 Argus and the Bristol Britannia airliner, powered by four Rolls-Royce Type turboprop engines. It will be available as a civil or military passenger transport or freighter and will have a maximum range of approximately 5,100 miles (8,200 km.) at a cruising speed of about 380 m.p.h. (611 km.h.). This will be sufficient for non-stop operation across the Atlantic in either direction regardless of headwinds.

An order for eight CL-44 transports for the R.C.A.F. was announced in the Spring of 1957, and when delivery of these aircraft begins in 1960 they will replace the Canadair North Stars at present in service with the R.C.A.F. Air Transport Command.

Designated CC-106 by the R.C.A.F., the CL-44 will accommodate approximately

150 passengers, or 66,500 lb. (30,164 kg.) of cargo, or a combination of both.

The structural description of the Britannia given under the "Bristol" entry in the "Great Britain" Section of this work applies to the CL-44D, with the following exceptions :—

LANDING GEAR.—Wheelbase 48 ft. 3 in. (14.70 m.).

POWER PLANT.—Four 5,500 e.s.h.p. Rolls-Royce Tyne 11 turboprop engines, driving de Havilland aluminium-alloy four-blade constant-speed feathering reverse-pitch airscrews, diameter 16 ft. (4.88 m.). Fuel in integral wing tanks and one central bag tank, with total capacity of 10,105 Imp. gallons (45,937 litres).

ACCOMMODATION.—Pressurised and air-conditioned cabin seats up to 150 passengers in high-density version. Normal accommodation for 123 passengers.

DIMENSIONS.—
Span 142 ft. 3½ in. (43.38 m.).
Length 136 ft. 8 in. (41.65 m.).
Height 37 ft. 3 in. (11.35 m.).

WEIGHTS.—
Take-off weight 205,000 lb. (92,986 kg.).
Landing weight 160,000 lb. (72,575 kg.).
Zero fuel weight 155,000 lb. (70,307 kg.).

PERFORMANCE (estimated).—
Cruising speed (passenger version) 380 m.p.h. (611 km.h.).
Cruising speed (cargo version) 375 m.p.h. (604 km.h.).
Stalling speed 108 m.p.h. (174 km.h.).
Max. range, with reserves 5,100 miles (8,200 km.).
Range with 150 passengers or 25 tons (25,400 kg.) cargo and reserves 4,200 miles (6,760 km.).
Range with max. cargo and reserves nearly 3,000 miles (4,825 km.).

THE CANADAIR CL-41.

Two prototypes of the Canadair-designed CL-41 two-seat side-by-side jet basic trainer are being built and the first was scheduled to fly in December, 1958.

Designed to meet all demands of a modern military all-through jet training syllabus, from *ab initio* to supersonic capability, the CL-41 prototypes are each powered by a Fairchild J83-R-1 lightweight turbojet engine, but provision is made for alternative engines.

Equipment includes dual blind-flying panels, an automatic emergency escape system for the crew and provision for light armament and external stores.

TYPE.—Two-seat Jet basic trainer.

WINGS.—Cantilever low-wing monoplane. NACA 63A014 section at root, NACA 63A212 section at tip. Aspect ratio 6.0. Chord at root 8 ft. 1 in. (2.46 m.), at tip 4 ft. (1.22 m.). Dihedral 4°. Incidence 1° at root, −½° at tip. Single-spar aluminium-alloy structure. Internally-sealed metal ailerons. Single-slotted metal flaps. Total area of ailerons 18.5 sq. ft. (1.72 m.²) aft of hinge. Total area of flaps 32.6 sq. ft. (3.04 m.²). Wing area 220 sq. ft. (20.44 m.²).

FUSELAGE.—Aluminium-alloy semi-monocoque structure.

TAIL UNIT.—Cantilever monoplane type, with tailplane mounted at tip of fin.



An impression of the Canadair CL-41 Jet Basic Trainer.

Aluminium-alloy structure. Areas: fin 17.5 sq. ft. (1.63 m.²), rudder 6.0 sq. ft. (0.56 m.²) aft of hinge, tailplane 41.3 sq. ft. (3.83 m.²), elevators 9.9 sq. ft. (0.92 m.²) aft of hinge. Tailplane span 13 ft. 8 in. (4.16 m.).

LANDING GEAR.—Retractable tricycle type. Oleo-pneumatic shock-absorbers. Hydraulic retraction. Wheels size 20 × 4.4. Disc-type brakes. Steerable nose-wheel. Wheel track 13 ft. 3 in. (4.04 m.). Wheelbase 11 ft. 1 in. (3.38 m.).

POWER PLANT.—One Fairchild J83-R-1 turbojet engine. Provision for alternative installation of Armstrong Siddeley Viper ASV.8, General Electric J85 or Pratt & Whitney JT-12 turbojet. Fuel in five cells in fuselage with total capacity of 250 Imp. gallons (1,135 litres). Provision for underwing tanks with total capacity of 125 Imp. gallons (567 litres).

ACCOMMODATION.—Crew of two side-by-side. Integrated escape system, openable down to ground level, automatically triggers canopy, oxygen and parachute in emergency.

DIMENSIONS. –
Span 36 ft. 4 in. (11.07 m.).
Length 15 ft. 6 in. (4.72 m.).
Height 9 ft. 5 in. (2.87 m.).

WEIGHTS.—
Weight loaded 6,500 lb. (2,950 kg.).

PERFORMANCE (estimated).—
Cruising speed 460 m.p.h. (740 km.h.).
Stalling speed 74 m.p.h. (119 km.h.).
Take-off distance to 50 ft. (15.25 m.) 1,800 ft. (550 m.).
Landing distance from 50 ft. (15.25 m.) 1,800 ft. (550 m.).
Range, with reserves 984 miles (1,585 km.).

THE CANADAIR CL-28.
R.C.A.F. designation: CP-107 Argus.

The CL-28 is a modification of the basic design of the Bristol Britannia to meet R.C.A.F. requirements for a long-range maritime reconnaissance aircraft and is the largest aircraft ever built in Canada.

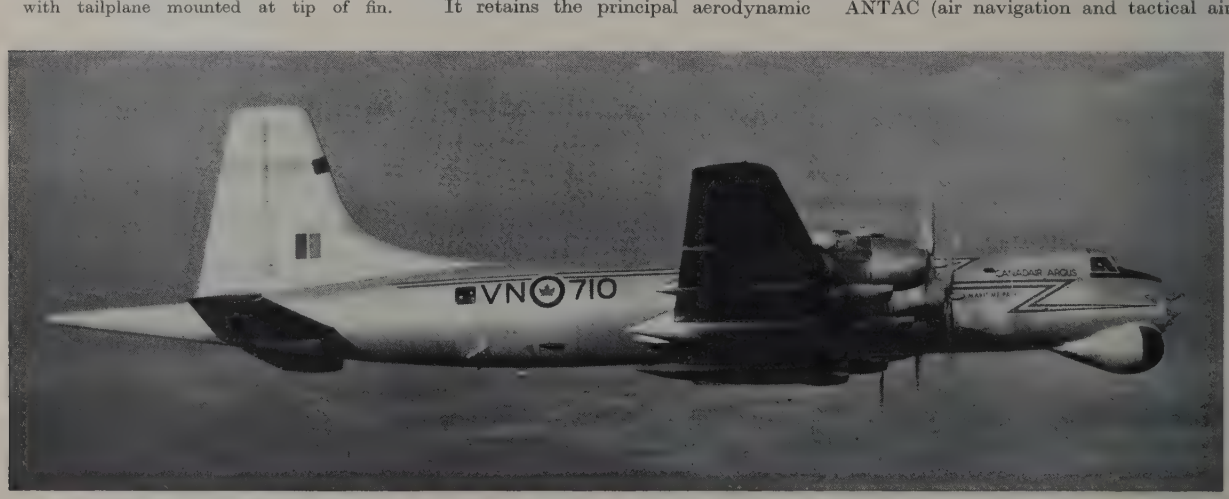
It retains the principal aerodynamic and structural features of the Britannia. Except for U.S. standardisation, the wings, tail surfaces, landing gear and primary flight controls of the Britannia remain substantially unchanged. The fuselage, while structurally similar, is unpressurised and is considerably modified both internally and externally.

The forward fuselage includes an observation or low-level bombing station, a large radome beneath the nose and a new forward crew compartment. Bomb-bays are provided forward and aft of the wings.

One modification to the wings is the addition of a small spoiler on the upper surface of each panel, inboard of the ailerons, to meet the requirement for a high rate of roll at low altitudes.

The power-plant consists of four 3,700 h.p. Wright R-3350 Turbo Compound engines, driving 15 ft. 6 in. (4.72 m.) Curtiss Electric three-blade airscrews, because the maritime reconnaissance rôle demands long-range operation at very low levels where a propeller-turbine power-plant would be unsuitable. The maximum fuel capacity of the CL-28 is 7,188 Imp. gallons (32,676 litres) in four wing tanks, which makes possible a maximum endurance of 24 hours at reconnaissance altitudes and speeds.

The CL-28 carries a crew of fifteen, consisting of three pilots, three navigators, two flight engineers and seven communications and electronics operators. There is provision for the carriage of the most up-to-date anti-submarine weapons and stores, together with 21 radio and radar installations, including search radar under the nose, an MAD (magnetic airborne detector) installation in a tail "sting" and ANTAC (air navigation and tactical air



The Canadair CL-28 Argus Maritime Reconnaissance Monoplane (four 3,700 h.p. Wright R-3350 Turbo Compound engines).



The Canadair CL-28 Argus Maritime Reconnaissance Monoplane (four 3,700 h.p. Wright R-3350 Turbo Compound engines).

control), specially developed for the CL-28 by Computing Devices of Canada.

The maximum all-up weight of the CL-28 (148,000 lb.=67,130 kg.) is slightly less than that of the Britannia Series 100.

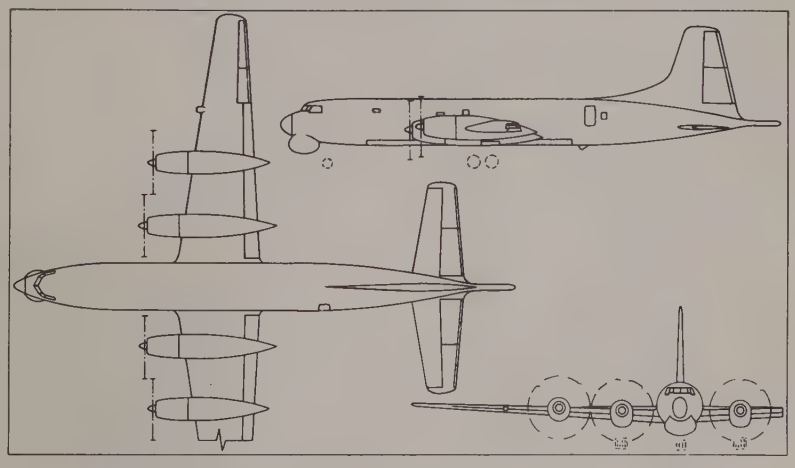
Work on the CL-28 began in April, 1954. All wing and tail surface structural drawings were re-drawn to American standards and North American equivalents were established for all materials and parts. The first CL-28 came off the assembly line on December 21, 1956 and flew on March 28, 1957.

The R.C.A.F. accepted its first CL-28 in September, 1957, and the type went into full service with the Maritime Air Command in May, 1958, after completing intensive test and development programmes.

DIMENSIONS.—
Span 142 ft. 3½ in. (43.38 m.).
Length 128 ft. 3 in. (39.09 m.).
Height 36 ft. 8½ in. (11.19 m.).

WEIGHTS.—
Take-off weight 148,000 lb. (67,130 kg.),
Landing weight 123,500 lb. (55,928 kg.).

PERFORMANCE.—
Max. speed over 290 m.p.h. (467 km.h.).
Cruising speed 175-200 m.p.h. (282-322 km.h.).
Stalling speed 95.5 m.p.h. (154 km.h.).
Service ceiling over 20,000 ft. (6,100 m.).
Range over 4,000 miles (6,440 km.).



The Canadair CL-28 Argus Maritime Reconnaissance Monoplane.

THE CANADAIR SABRE.

The following are the principal versions of the Canadair Sabre which was built under licence from North American Aviation, Inc., between 1949 and 1958.

Sabre Mk. 1. Prototype only. Based on the F-86A. First flew on August 9, 1950.

Sabre Mk. 2. First production version for the R.C.A.F. Based on the F-86E with "all-flying" tail and powered by the General Electric J47 turbojet engine obtained from the U.S.A.

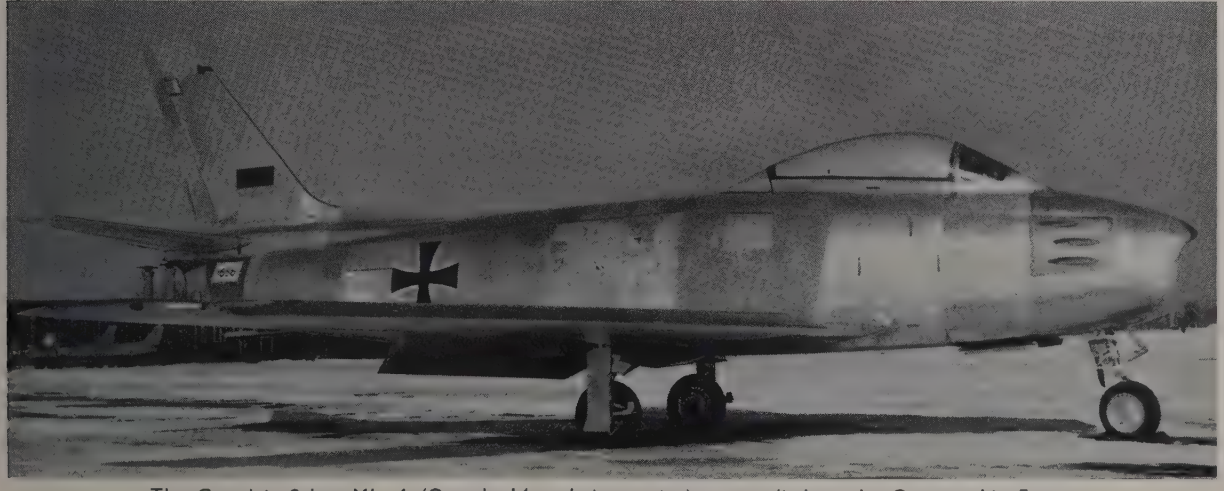
Sabre Mk. 3. Mk. 2 fitted with the Orenda 10 engine (6,500 lb.=2,950 kg. s.t.). Prototype for the Mk. 5. First flew early in 1953.

Sabre Mk. 4. Later production version of the Mk. 2, for the Royal Air Force.

Sabre Mk. 5. Powered by the Orenda 10 engine (6,500 lb.=2,950 kg. s.t.) and fitted with the 6/3 wing first used on the F-86F. First production Mk. 5 flew on July 30, 1953.

Sabre Mk. 6. Development of Mk. 5 with higher-powered Orenda 14 engine with two-stage turbine (7,200 lb.=3,270 kg. s.t.) and re-designed slatted wing leading-edge. Primarily a high-altitude fighter but can be used for ground attack with bombs and rockets. For bomber interception guided weapons may be carried. Standard equipment of R.C.A.F. No. 1 Air Division in Europe in 1955-58.

Sabre Mk. 7. Projected new version,



The Canadair Sabre Mk. 6 (Orenda 14 turbojet engine) as supplied to the German Air Force.

armed with guided missiles for high-altitude interception duties.

Altogether, more than 1,800 Sabres were built before production was phased out in October, 1958. They are still serving with the R.C.A.F. (including reserve squadrons), the U.S.A.F. (for training) and the Greek, Turkish, Italian, Yugoslav, South African, Colombian and West German Air Forces.

DIMENSIONS (Sabre Mk. 6).—
Span 37 ft. 1¼ in. (11.32 m.).
Length 37 ft. 6 in. (11.43 m.).
Height 14 ft. 9 in. (4.49 m.).

THE CANADAIR SILVER STAR.

The Silver Star, which was built under a licence from the Lockheed Aircraft Corporation, is the T-33A two-seat jet trainer powered by a Rolls-Royce Nene 10 turbojet engine (5,100 lb.=2,315 kg. s.t.). The first Nene-powered Silver Star flew for the first time in October, 1952, and the first production aircraft was delivered to the R.C.A.F. in January, 1953. More than 700 were built before production ended in January, 1959. They remain in service with the R.C.A.F., R.C.N., and the Greek and Turkish air forces.

DIMENSIONS.—
Span 42 ft. 5 in. (12.93 m.).
Length 37 ft. 8 in. (11.48 m.).
Height 11 ft. 8 in. (3.55 m.).

DE HAVILLAND

THE DE HAVILLAND AIRCRAFT OF CANADA, LTD.

HEAD OFFICE AND WORKS: DOWNSVIEW, ONTARIO.

Managing Director: P. C. Garratt.
Engineering Director: W. D. Hunter.
Sales Director: C. H. Dickins.
Director of Operations: R. Bannock.
Production Manager: W. C. Burlison.
Secretary and Treasurer: G. J. Mickleborough.

The de Havilland Aircraft of Canada Ltd., was established early in 1928 by the de Havilland Aircraft Co., Ltd., as a Canadian constructional plant and service depot for D.H. aircraft.

The authorised capital of the Company is $500,000, of which $306,000 has been issued.

Considerable experimental work has been done in order to produce components and special accessories to meet all Canadian flying conditions.

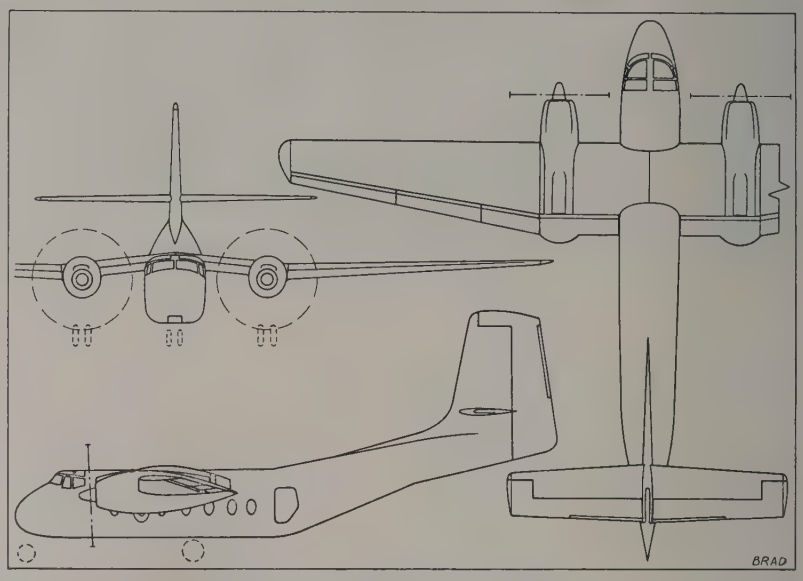
Since the end of the war the company has flown three aircraft of original design —the DHC-1 Chipmunk two-seat trainer, and the DHC-2 Beaver and DHC-3 Otter, both single-engined cabin monoplanes designed for Canadian "bush" operations.

Initial production of a large number of Chipmunks was completed in 1951; but the type was put back into production in 1955 to meet new R.C.A.F. requirements. A full description of this aircraft has appeared in earlier editions of "All the World's Aircraft."

Well over 1,200 military and civil Beavers have been built, the majority of the military Beavers being for delivery to the U.S. Air Force and Army. The Beaver is now in wide use throughout Canada and in 58 foreign countries.

The Otter also has been in continuous production since March, 1953, and more than 250 have been delivered to the Royal Canadian Air Force, Royal Norwegian Air Force, U.S. Navy, U.S. Army, Chilean Air Force, Indian Air Force and commercial operators.

In March, 1957, it was announced that the U.S. Army had placed an order for five twin-engined transports of an entirely new type known as the DHC-4 Caribou.



The de Havilland DHC-4 Caribou.

Delivery of these is scheduled to begin early in 1959.

The de Havilland Aircraft of Canada, Ltd. was awarded in March, 1954, a prime contract to build the Grumman S2F twin-engined anti-submarine monoplane under licence for the Royal Canadian Navy. Delivery of the first D.H.-built CS2F took place on October 12, 1956.

THE DHC-4 CARIBOU.

Canadian Army designation: CC-108.
U.S. Army designation: YC-1B.

The decision to proceed with the design and development of this twin-engined transport aircraft was taken in 1956 after nearly two years of design study. Two prototypes are being developed in co-operation with the Canadian Army and Department of Defence Production, and the first of these flew for the first time on July 30, 1958. After completion of its Civil Airworthiness tests, it will be turned over to the Canadian Army for evaluation.

Five more Caribous have been ordered by the U.S. Army, and delivery of these is scheduled to begin early in 1959.

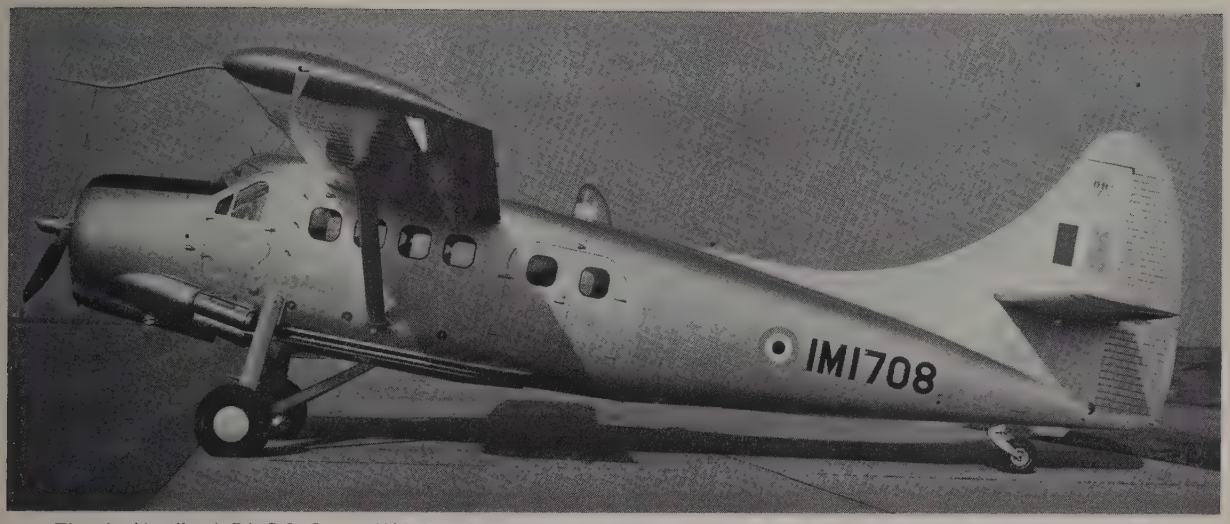
In addition to the seven aircraft mentioned above, present schedules call for completion of a further ten aircraft by the end of 1959.

The Caribou combines a load-carrying capacity comparable with that of the DC-3, with a short take-off and landing performance as good as, or even better than, the Beaver and Otter. Its primary purpose as a military vehicle is to provide rapid mobility for troops, equipment and supplies in forward battle areas, and as a commercial transport for low-cost transportation of passengers and cargo in undeveloped areas.

The clear unobstructed cabin is fitted with large rear-loading doors which permit air-drop of heavy equipment. An adjustable loading ramp and freight-winching facilities provide for rapid



The prototype de Havilland DHC-4 Caribou Transport (two 1,450 h.p. Pratt & Whitney R-2000 engines).



The de Havilland DHC-3 Otter (600 h.p. Pratt & Whitney R-1340 engine) in the colours of the Indian Air Force.

loading and ensure a quick turn-round on the ground.

TYPE.—Twin-engined All-weather Utility transport.

WINGS.—High-wing cantilever monoplane. Aspect ratio 10. All-metal structure. Full span double-slotted flaps, outer trailing portions operated independently as ailerons. Gross wing area 912 sq. ft. (84.72 m.²).

FUSELAGE.—All-metal structure. Rear portion is upswept aft of wings, with upward and inward hingeing door forming underside of rear fuselage.

TAIL UNIT.—Cantilever monoplane tail with conventional single fin and rudder. All-metal structure. Total area of fin and rudder 211 sq. ft. (19.6 m.²). Total area of tailplane and elevators 228 sq. ft. (21.2 m.²). Tailplane span 36 ft. (11.0 m.).

LANDING GEAR.—Retractable tricycle type.

POWER PLANT.—Two Pratt & Whitney R-2000-D5 fourteen-cylinder two-row radial air-cooled engines, with 1,450 h.p. available at 2,700 r.p.m. for take-off and maximum continuous rating of 1,200 h.p. at 2,550 r.p.m. Alternatively, there is provision for the later installation of turboprop power plants. Fuel in internal wing tanks.

ACCOMMODATION.—Flight compartment seats two side-by-side. Cabin will accommodate up to 32 passengers on normal commercial type seats or 28 fully-equipped troops on military bench-seats. A cargo of 7,300 lb. (3,320 kg.) can be carried on a 200-mile (320-km.) stage distance. Ambulance version will carry combinations of up to 14 stretchers and 8 seated persons. Cabin floor dimensions 25 ft. (7.6 m.) long by 6 ft. 1½ in. (1.9 m.) wide. Maximum cabin width 6 ft. 11 in. (2.11 m.). Cabin height 6 ft. 2 in. (1.9 m.). Cabin volume 1,000 cub. ft. (28.3 m.³). Floor height from ground 45 in. (1.1 m.). Clear height under tail for loading 9 ft. 6 in. (2.9 m.).

DIMENSIONS.—
Span (over wing-tips) 96 ft. (29.2 m.).
Length 68 ft. 10 in. (21.0 m.).
Height 31 ft. 9 in. (9.7 m.).

WEIGHTS.—
Weight empty 14,700 lb. (6,670 kg.).
Design gross weight 24,000 lb. (10,886 kg.).

PERFORMANCE (estimated).—
Cruising speed (750 h.p.) at 7,500 ft. (2,285 m.) 183 m.p.h. (294 km.h.).
Stalling speed 59 m.p.h. (95 km.h.).
Rate of climb at S/L 1,570 ft./min. (478 m./min.).
Single-engine rate of climb at S/L 315 ft./min. (96 m./min.).
Rate of climb at 5,000 ft. (1,525 m.) 1,560 ft./min. (475 m./min.).
Single-engine rate of climb at 5,000 ft. (1,525 m.) 280 ft./min. (85 m./min.).
Absolute ceiling 26,000 ft. (7,925 m.).
Single-engine ceiling 13,000 ft. (3,962 m.).
Take-off distance, 10 m.p.h. (16 km.h.) wind, 330 ft. (100 m.).
Take-off distance to 50 ft. (15.25 m.) zero wind 800 ft. (244 m.).
Landing distance from 50 ft. (15.25 m.) zero wind 800 ft. (244 m.).
Range with 6,000 lb. (2,720 kg.) payload 600 miles (965 km.).
Range with 6,700 lb. (3,039 kg.) payload 400 miles (645 km.).
Range with 7,300 lb. (3,320 kg.) payload 200 miles (322 km.).
Max. range 1,350 miles (2,170 km.).

THE DHC-3 OTTER.

U.S. Army designation: U-1.
U.S. Navy designation: UC-1.

The Otter, which flew for the first time on December 12, 1951, received its Certificate of Airworthiness both as a landplane and seaplane in October, 1952, and thereupon became the first single-engined aircraft to qualify for approval in accordance with ICAO Category D airworthiness requirements.

Otters delivered to the R.C.A.F. are engaged on Arctic Search and Rescue operation, paratroop dropping and aerial photographic duties. Commercially, Otters are operating over a wide range of climatic conditions, including territories such as Norway, Colombia, India and the Philippine Islands.

Early in 1955 D.H. Canada began production of 90 Otters for the U.S. Army under the designation U-1A. The Otter is also being produced for the U.S. Navy as the UC-1 and aircraft of this type accompanied the U.S. "Operation Deepfreeze" expedition to the Antarctic in 1956-58.

An Otter provided the sole transport and reconnaissance support for the British component of the 1957-58 Commonwealth Trans-Antarctic Expedition and this aircraft flown by an R.A.F. crew made an outstanding 11-hour flight across the Antarctic continent and over the South Pole on January 6, 1958.

TYPE.—Single-engined nine/eleven-passenger General Utility Transport.

WINGS.—High-wing braced monoplane. D.H. high-lift wing section. Aspect ratio 8.97. Dihedral 2°. All-metal structure. Single



The de Havilland DHC-3 Otter Seaplane (600 h.p. Pratt & Whitney R-1340 engine).

bracing strut on each side. Slotted inset ailerons. Double slotted flaps. Ailerons and flaps all-metal. Total aileron area 26.3 sq. ft. (2.44 m.²). Total area of flaps 98 sq. ft. (9.10 m.²). Gross wing area 375 sq. ft. (34.84 m.²).

FUSELAGE.—Of conventional all-metal structure.

TAIL UNIT.—Cantilever monoplane type with tailplane halfway up fin which is integral with fuselage. All-metal structure. Total vertical area 60.2 sq. ft. (5.6 m.²). Total horizontal area 84.0 sq. ft. (7.8 m.²). Span of tail 21 ft. 2 in. (6.46 m.).

LANDING GEAR.—Interchangeable wheels, floats or skis. Wheel gear has D.H. rubber-in-compression springing. Goodyear wheels and brakes. Track 11 ft. 2 in. (3.42 m.). Wheelbase 27 ft. 10 in. (8.49 m.). Wheels interchangeable with D.H. skis or twin Edo 7170 all-metal single-step floats. Float base (C/L. of floats) 10 ft. 6 in. (3.20 m.). A combination wheel-ski landing-gear designed and manufactured by D.H. is available. The change from wheels to skis or *vice versa* is accomplished from the cockpit by hydraulic pump.

POWER PLANT.—One 600 h.p. Pratt & Whitney R-1340-S1H1-G or S3H1-G radial air-cooled engine driving a three-blade Hamilton Standard Hydromatic airscrew 10 ft. 10 in. (3.3 m.) diameter. Special exhaust system with four augmentor stacks. In these stacks exhaust gases produce suction strong enough to pull cooling air through engine and from behind engine accessories compartment while at same time providing measurable amount of thrust in cruising flight. Engine is effectively cooled during steep climbs when forward air speed is low and engine output near its maximum. Fuel tanks under cabin floor. Capacities: front 51 Imp. gallons (230 litres), middle (two cells) 85 Imp. gallons (386 litres), rear 42 Imp. gallons (190 litres). Total internal fuel capacity: 178 Imp. gallons (830 litres). Oil capacity 9 Imp. gallons (41 litres). Oil dilution system. Remote control fire-extinguisher system in engine compartment.

ACCOMMODATION.—Pilot's compartment seats two side-by-side, pilot (port) and co-pilot or passenger. Dual rudder pedals and W-type control column with throw-over wheel. Door on each side and one in bulkhead to cabin. Cabin is 16 ft. 5 in. (5.0 m.) long, 5 ft. 2 in. (1.58 m.) wide and 4 ft. 11 in. (1.5 m.) high, divided by bulkhead into 12 ft. 8 in. (3.8 m.) long main passenger or freight compartment and stowage compartment. Volume of main compartment 272 cub. ft. (7.6 m.³), of stowage compartment 38 cub. ft. (1.06 m.³). Doors on each side of main compartment 46.5 in. (118 cm.) wide on port, 30 in. (76.2 cm.) wide on starboard. Reinforced cargo floor. Cargo drop hatch, camera hole or para-troop exit in floor of stowage compartment. Standard seating accommodation—9 folding seats for passengers in cabin, plus one in cockpit. Tenth seat in cabin available as optional extra. Alternatively, 6 stretchers and 4 passenger seats or 3 stretchers and 7 passenger seats. All seats quickly removable.

EQUIPMENT.—A 28-volt electrical system charged by a 50 or 100 amp. generator is provided. Navigation lights, controllable-intensity instrument lights, a 250-watt sealed-beam landing-light in the port wing leading-edge and cabin lights are provided. Racks in the stowage compartment give accessible installation to the battery and to radio and navigation equipment specified by the operator.

DIMENSIONS.—
Span 58 ft. (17.69 m.).
Length (landplane and seaplane) 41 ft 10 in. (12.80 m.).
Height (landplane) 12 ft. 7 in. (3.83 m.).
Height (seaplane) 15 ft. 0 in. (4.57 m.).

WEIGHTS.—
Weight empty (landplane) 4,168 lb. (1,891 kg.).
Weight empty (seaplane) 4,620 lb. (2,096 kg.).
Weight empty (fixed skis) 4,361 lb. (1,978 kg.).
Weight empty (wheel/ski gear) 4,475 lb. (2,030 kg.).
Weight loaded (landplane) 8,000 lb. (3,630 kg.).
Weight loaded (seaplane) 7,967 lb. (3,613 kg.).

PERFORMANCE (Landplane).—
Max. true level speed (600 h.p.) 160 m.p.h. (257 km.h.) at 5,000 ft. (1,525 m.).
True cruising speed (400 h.p.) 138 m.p.h. (222 km.h.) at 5,000 ft. (1,525 m.).
Rate of climb at S/L. (600 h.p.) 735 ft./min. (222 m./min.).
Service ceiling (S1H1-G engine) 18,800 ft. (5,730 m.).
Service ceiling (S3H1-G engine) 17,400 ft. (5,300 m.).
Max. range (full tanks) 960 miles (1,545 km.) at 5,000 ft. (1,525 m.).
Max. endurance 9.4 hours at 5,000 ft. (1,525 m.).
Take-off distance to 50 ft. (15.25 m.) (no wind) 1,310 ft. (400 m.).
Landing distance from 50 ft. (15.25 m.) 975 ft. (297 m.).

PERFORMANCE (Seaplane).—
Max. true level speed (600 h.p.) 153 m.p.h. (245 km.h.) at 5,000 ft. (1,525 m.).
True cruising speed (400 h.p.) 129 m.p.h. (207 km.h.) at 5,000 ft. (1,525 m.).
Rate of climb at S/L. 650 ft./min. (198 m./min.).
Service ceiling (S1H1-G engine) 17,900 ft. (5,450 m.).
Service ceiling (S3H1-G engine) 16,400 ft. (5,000 m.).
Max. range (full tanks) 863 miles (1,385 km.) at 5,000 ft. (1,525 m.).
Max. endurance 8.9 hours at 5,000 ft. (1,525 m.).
Take-off distance to 50 ft. (15.25 m.) 1,980 ft. (605 m.).
Landing distance from 50 ft. (15.25 m.) 1,210 ft. (369 m.).

PERFORMANCE (Skiplane).—
Max. true level speed (600 h.p.) 158 m.p.h. (254 km.h.) at 5,000 ft. (1,525 m.).
True cruising speed (400 h.p.) 133 m.p.h. (214 km.h.) at 5,000 ft. (1,525 m.).
Service ceiling (S3H1-G engine) 17,100 ft. (5,200 m.).
Service ceiling (S1H1-G engine) 18,600 ft. (5,670 m.).
Rate of climb (600 h.p.) 690 ft./min. (210 m./min.).

NOTE.—Range and endurance include allowances for 10 min. warm-up, take-off, climb to 5,000 ft. (1,525 m.) and fuel for 45 minutes at cruise power in reserve.

THE DHC-3 OTTER AMPHIBIAN.

An amphibian gear has been produced for the Otter by modifying standard Edo floats to accommodate retractable main and nose-wheels, combined with a slight lengthening of the floats to give sufficient increase in buoyancy to offset the wheel wells.

The main wheels are installed immediately aft of the step and retract into wells in the floats, while the nose-wheels lift forward and upward through 270° to lie in wells on the deck of the floats. All wheels and the standard landplane single disc brakes fitted to them are made of aluminium instead of magnesium to ensure maximum corrosion resistance.

Retraction is hydraulic, either by hand-pump or an electro-hydraulic power unit. In the "down" position, the wheels are fixed by hydraulic locking pins. The nose-wheels are fully-swivelling, with self-centering tyres to prevent shimmy. Handling on the ground is easier than with the standard landplane version because of the nose-wheel configuration.

Compared with the standard seaplane version, the Otter amphibian suffers little penalty in performance, the cruising speed being reduced by approximately 4 m.p.h. (6.4 km.h.). Take-off distance to 50 ft. (15.25 m.) on land is increased by only 130 ft. (40 m.) to 1,440 ft. (439 m.).

WEIGHTS.—
Weight empty 5,287 lb. (2,398 kg.).
Weight loaded 8,000 lb. (3,630 kg.).

THE DHC-2 BEAVER.

U.S. Army and U.S.A.F. designation: L-20.

More than 1,200 Beavers have been built for commercial operators and for the U.S. Army, with which the L-20



The de Havilland DHC-3 Otter Amphibian (600 h.p. Pratt & Whitney R-1340 engine).

version is standard equipment. A single Beaver Mk. 2 was built with a 570 h.p. Alvis Leonides Series 502/4 engine and correspondingly improved performance. A description of this aircraft appeared in earlier editions of "All the World's Aircraft." The following data apply to the standard version with Wasp Junior engine.

TYPE.—Single-engined seven-seat landplane, seaplane or skiplane which may be used for military liaison and communications, military and civil cargo transportation, ambulance and rescue duties and civil agricultural and forestry operations.

WINGS.—High-wing braced monoplane. D.H. high-lift wing section. All-metal two-spar structure. Single bracing struts on each side. Entire trailing-edge hinged. Slotted ailerons and flaps interconnected so that when flaps are lowered to maximum angle of 58° the ailerons droop progressively to about 15° while retaining full lateral control. Hydraulic flap operation. Gross wing area 250 sq. ft. (23.2 m.²).

FUSELAGE.—Rectangular all-metal structure.

TAIL UNIT.—Cantilever monoplane type. All-metal structure including covering.

LANDING GEAR.—Interchangeable floats, wheels and skis. Rubber-in-compression cantilever single-leg wheel gear with steerable tail-wheel. Goodyear wheels and brakes. Twin Edo Model 58-4580 all-metal floats. Float base (C/L of floats) 9 ft. 6¾ in. (2.92 m.). A combination wheel-ski gear designed and manufactured by D.H. is also available. The change-over from wheels to skis or *vice versa* is accomplished from the cockpit by hydraulic pump.

POWER PLANT.—One 450 h.p. Pratt & Whitney R-985 Wasp Junior nine-cylinder radial air-cooled engine driving a two-blade Hamilton Standard controllable-pitch airscrew 8 ft. 6 in. (2.59 m.) diameter. Fuel tanks (3) are under the cabin floor and easily removable for servicing. Tank fillers in fuselage sides to permit refuelling from ground or floats. Maximum internal fuel capacity 79 Imp. gallons (359 litres). Provision for wing-tip tanks of 36 Imp. gallons (165 litres) capacity. Oil tank and cooler in engine compartment aft of firewall. Oil-dilution system. Hand and electric starters. Remote-control fire-extinguishing system in engine compartment in civil version only.

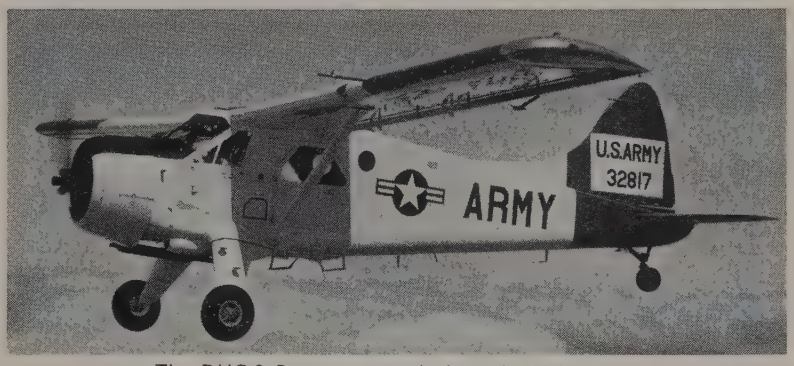
ACCOMMODATION.—Pilot's compartment with pilot on port side and removable seat on starboard. Dual rudder pedals and Y-type control column with throw-over wheel. Entrance door with automobile-type sliding windows on each side. Cabin may seat seven passengers. Cabin heating. Floor stressed for freight-carrying. Lightweight collapsible bush-seats are interchangeable with cargo attachments. Two side doors, one on each side, wide enough to roll a 45-gallon petrol drum into cabin on its side. Hatches in rear wall of cabin to enable long pieces of freight, such as 10 ft. drilling-rods, to be loaded and stowed. Adequate baggage space at back of cabin, with separate locker aft for emergency rations, etc.. Total cabin capacity 144 cub. ft. (4.07 m.³). Capacity available for freight payload 120 cub. ft. (3.35 m.³).

EQUIPMENT.—24-volt electrical system charged by engine-driven 1,500-watt generator. Batteries in rear fuselage on removable tray accessible through fuselage side. Provision for navigation lights, instrument lighting, anchor riding light and cabin lights. Fittings on floats chassis for 16 ft. canoe. Extra equipment to operators' specifications include radio, agricultural spraying or dusting equipment, etc.

DIMENSIONS.—
Span 48 ft. (14.64 m.).
Length (landplane) 30 ft. 3 in. (9.22 m.).
Length (seaplane) 32 ft. 9 in. (9.98 m.).
Height (landplane) 9 ft. 0 in. (2.75 m.).
Height (seaplane) 10 ft. 5 in. (3.18 m.).

WEIGHTS (Landplane).—
Weight empty 2,850 lb. (1,293 kg.).
Weight loaded 5,100 lb. (2,315 kg.).

WEIGHTS (Seaplane).—
Weight empty 3,168 lb. (1,437 kg.).
Weight loaded 5,100 lb. (2,315 kg.).



The DHC-2 Beaver as supplied to the U.S. Army.

PERFORMANCE (Landplane).—
Max. true level speed (450 h.p.) 163 m.p.h. (262 km.h.) at 5,000 ft. (1,525 m.).
True cruising speed (300 h.p.) 143 m.p.h. (230 km.h.) at 5,000 ft. (1,525 m.).
Rate of climb at S/L. (450 h.p.) 1,020 ft./min. (311 m./min.).
Service ceiling 18,000 ft. (5,490 m.).
Cruising range (240 h.p.—internal fuel only) 455 miles (733 km.) at 5,000 ft. (1,525 m.).
Cruising range (240 h.p.—with wing-tip tanks) 733 miles (1,190 km.) at 5,000 ft. (1,525 m.).
Take-off distance to 50 ft. (15.25 m.) 1,015 ft. (310 m.).
Landing distance from 50 ft. (15.25 m.) 990 ft. (302 m.).

PERFORMANCE (Seaplane).—
Max. true level speed (450 h.p.) 151 m.p.h. (243 km.h.) at 5,000 ft. (1,525 m.).
True cruising speed (300 h.p.) 127 m.p.h. (204 km.h.) at 5,000 ft. (1,525 m.).
Rate of climb at S/L. (450 h.p.) 965 ft./min. (294 m./min.).
Service ceiling 15,750 ft. (4,810 m.).
Cruising range (internal fuel only) 405 miles (652 km.).
Cruising range (with wing-tip tanks) 655 miles (1,052 km.).
Take-off distance to 50 ft. (15.25 m.) 1,300 ft. (396 m.).
Landing distance from 50 ft. (15.25 m.) 1,210 ft. (369 m.).

NOTE.—Ranges include allowance for 10 minute warm-up, take-off, climb to 5,000 ft. and reserve fuel for 45 minutes flight at cruise power.

THE DHC-2 BEAVER AMPHIBIAN.

An amphibian gear has been designed for use with the Edo Model 58-4580 floats currently fitted to the Beaver. This gear makes use of the standard main wheels and brakes with which the landplane is normally fitted.

The main wheels are suspended below the floats aft of the step on levered rubber shock-absorbers and retract into wells in the floats. Functioning components of the shock-absorbing and retracting systems are completely enclosed within the float shell and are not exposed to water.

A nose-wheel unit is mounted on the front bulkhead of each float and when not in use is rotated up and over to lie on the float deck. A levered rubber shock-absorbing system is also used in the nose-wheel installation. The nose-wheels are free-swivelling and are fitted with anti-shimmy twin-contact tyres. A centering lock is also provided for each nose-wheel to prevent misalignment when in the retracted position.

Retraction is by hydraulic jacks at each wheel unit, operated from a hand-pump and selector control in the cockpit. Both main and nose-wheel systems are fitted with mechanical down-locks, which are automatically released for the retraction cycle. A position indicator is fitted on the cockpit control unit.

Compared with the standard seaplane, the Beaver amphibian suffers no measurable penalty in performance. Fully loaded and in zero wind, the amphibian is airborne in 885 ft. (270 m.) on water. As a landplane the amphibian taxis and handles easily and take-off and landing distances are affected only slightly. Fully-loaded and in zero wind the take-off is accomplished in 595 ft. (181 m.).

WEIGHTS.—
Weight empty 3,641 lb. (1,652 kg.).
Weight loaded (on land) 5,100 lb. (2,313 kg.).
Weight loaded (on water) 5,000 lb. (2,268 kg.).



The DHC-2 Beaver Amphibian (450 h.p. Pratt & Whitney R-985 engine).

FAIREY

THE FAIREY AVIATION COMPANY OF CANADA LTD.

HEAD OFFICE AND PRINCIPAL PLANT: EASTERN PASSAGE, HALIFAX COUNTY, N.S.

BRANCH PLANT: PATRICIA BAY AIRPORT, SIDNEY, B.C.

President: S. G. Dixon, O.B.E., Q.C.
Managing Director: C. E. Hibbert, M.B.E.
Chief Designer: E. C. Garrard, A.M.I. Mech.E., A.F.R.Ae.S., A.F.C.A.I., A.F.I.A.S.
Secretary-Treasurer: A. M. Cameron, F.C.I.S.

The Fairey Aviation Co. of Canada Ltd. was incorporated in November, 1948, initially to undertake the maintenance, overhaul and repair of aircraft for the Royal Canadian Navy. Early in 1955, the Branch Plant was established at Patricia Bay on Vancouver Island.

Both plants are currently engaged in

the maintenance, repair, overhaul and conversion of aircraft for the Royal Canadian Navy and the Royal Canadian Air Force. The principal types handled at Eastern Passage for the R.C.N. are the F2H-3 Banshee jet-fighter and the Canadian-built CS2F Tracker anti-submarine aircraft. For the R.C.A.F., the P2V-7 Neptune and Lancaster are being modified and overhauled. Major contracts have included modification of Lancaster Mk. 10S to Mk. 10DC, to carry Firebee target drones, and equipping Banshees to carry Sidewinder air-to-air missiles.

Component manufacture at the Eastern Passage plant included production of hydraulic flying control booster units for the Avro CF-100 fighter.

At Patricia Bay, maintenance, repair, overhaul and modification programmes have been carried out on Harvard, Avenger, Lancaster and Canso aircraft. In addition, many types of light and heavy commercial aircraft passed through this plant during 1957-58.

VERTOL



The Vertol Model 42A Utility Helicopter, the Canadian modification of the military H-21B.

VERTOL AIRCRAFT COMPANY (CANADA) LTD.

HEAD OFFICE AND WORKS: ARNPRIOR, ONTARIO.

Vice-President and General Manager: Max Bowen.
Vice-President: Dr. Felix A. Kalinski.
Chief Development Engineer: Karl Fritsch.
Treasurer: Hamilton Lord.
Secretary: John O'Hara.

This company is a wholly-owned subsidiary of the Vertol Aircraft Corporation of Morton, Pennsylvania, but is administered as an independent company. It was formed in February, 1954 with a nucleus of 10 employees, which had grown to a total of 70 persons by the beginning of 1958. Its plant, with a floor area of 42,500 sq. ft. (3,950 m.²), is on the former R.C.A.F. airfield at Arnprior, fifty miles west of Ottawa.

Major work undertaken by the company is the servicing and overhaul of helicopters and helicopter components. In particular, it is concerned with the Vertol H-21 and Model 44 helicopters owned by the R.C.A.F., the Vertol HUP's of the Royal Canadian Navy and the Vertol Model 42's operated by Spartan Air Services, Ltd. In addition to overhaul of complete aircraft and components at Arnprior, mobile repair parties are sent to helicopter units operating in remote areas of Canada.

Following completion of a flight test programme with a Vertol H-21 at Arnprior, both the U.S. Civil Aeronautics Administration and the Canadian Department of Transport granted, in April, 1957, Type Approval for the Vertol Model 42A helicopter, which is basically the H-21 with modifications to suit it for civil use.

Vertol Aircraft Company (Canada) was then given a contract to modify eight former R.C.A.F. H-21B aircraft to Model 42A standard. This work was completed by the end of June, 1958 and, after receiving their D.O.T. Certificates of Airworthiness, the eight helicopters were delivered to Spartan Air Services for supply duties in support of the Mid-Canada radar chain.

The Model 42A is produced exclusively by the Canadian company, and details of it are given hereafter.

THE VERTOL MODEL 42A.

TYPE.—Tandem-rotor Utility helicopter.

ROTOR SYSTEM.—Two three-blade rotors in tandem. Rotor blades have tubular-steel spar and plywood covering. Blades attached to hub by pitch link incorporating horizontal and vertical pins. Hub is steel forging. Area of each blade 30 sq. ft. (2.79 m.²). Total disc area (both rotors) 3,040 sq. ft. (282.4 m.²). No anti-torque rotors.

ROTOR DRIVE.—By shafts, through planetary reduction gear. Rotor/engine r.p.m. ratio 9.7 : 1.

FUSELAGE.—All-metal semi-monocoque structure.

LANDING GEAR.—Non-retractable tricycle type. Cleveland Pneumatic oleo shock-absorbers. Goodyear wheels and tyres, size 24 × 7.7. Tyre pressure 150 lb./sq. in. (10.55 kg./cm.²). Wheel track 13 ft. 4 in. (4.06 m.). Wheelbase 24 ft. 8 in. (7.52 m.).

POWER PLANT.—One Wright R-1820-103 nine-cylinder radial air-cooled engine, developing 1,425 h.p. for take-off and with normal rated power of 1,275 h.p. Engine inside rear fuselage, with cooling fan. Fuel tank in fuselage aft of main cabin, capacity 300 U.S. gallons (1,136 litres). Oil capacity 21 U.S. gallons (82 litres).

ACCOMMODATION.—Crew of one or two and 19 passengers or 2,820 lb. (1,280 kg.) of cargo, with full fuel and oil. Cargo sling of 5,000 lb. (2,268 kg.) capacity for carrying external loads.

DIMENSIONS.—
Rotor diameter (each) 44 ft. 0 in. (13.41 m.).
Overall length 86 ft. 4 in. (26.3 m.).
Fuselage length 52 ft. 6 in. (16.0 m.).
Overall width, blades folded 14 ft. 4 in. (4.37 m.).
Height 15 ft. 6 in. (4.72 m.).

WEIGHTS.—
Weight empty 9,063 lb. (4,111 kg.).
Weight loaded 14,000 lb. (6,350 kg.).

PERFORMANCE.—
Max. speed at S/L 127 m.p.h. (204 km.h.).
Cruising speed at S/L 97 m.p.h. (156 km.h.).
Max. rate of climb at S/L 945 ft./min. (288 m./min.).
Vertical rate of climb at S/L 600 ft./min. (183 m./min.).
Service ceiling 7,500 ft. (2,285 m.).
Hovering ceiling out of ground effect 1,450 ft. (442 m.).
Range 300 miles (480 km.).

INDIA

HINDUSTAN

HINDUSTAN AIRCRAFT (PRIVATE) LTD.

HEAD OFFICE AND WORKS: BANGALORE (MYSORE STATE).

Chairman of the Board of Directors: M. K. Vellodi, Secretary, Ministry of Defence, Government of India.

Managing Director and General Manager: Air Vice-Marshal A. M. Engineer, D.F.C., I.A.F. (Ret.).

Deputy General Manager (Engines): P. M. Reddy.

Chief Designer: Dr. V. M. Ghatage, M.Sc., D.Phil., A.F.R.Ae.S., M.I.Ae.S., F.A.Sc., A.M.I.E., F.Ae.S.I.

Financial Manager: V. G. Kamath.

Production Adviser: J. J. M. Dziewonski, A.M.I.Mech.E., A.F.R.Ae.S., M.S.A.E.

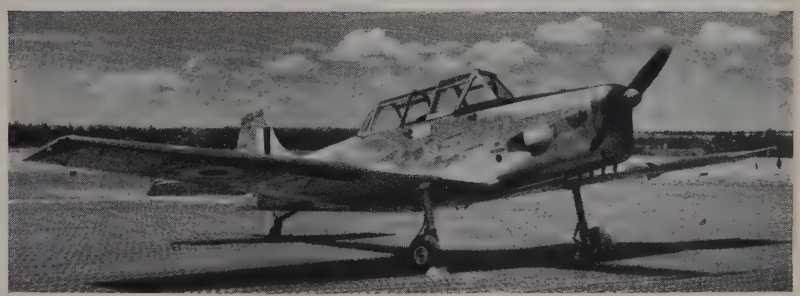
Factory Manager: Albert Zampolino.

Hindustan Aircraft (Private) Ltd. is India's only aircraft manufacturing establishment. It serves not only India's domestic needs, but also those of many of the airline operators and air forces in Asian countries and the Middle East.

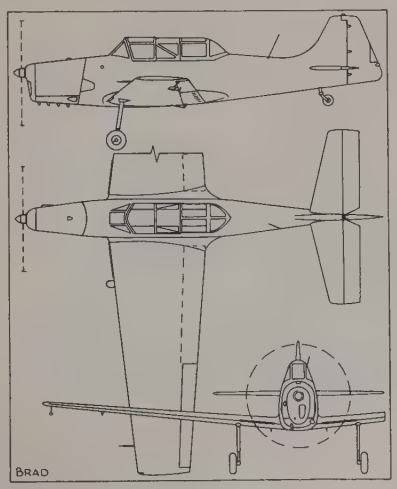
On the manufacturing side, the HT-2 trainer is now in production and is in Service in the Indian Air Force and the Indian Naval Air Arm, as well as with the Civil Aviation Training Establishments and Flying Clubs. The HT-2 is also in service in Singapore under the auspices of the Colombo Plan. The HT-2 is now available for export and it has been demonstrated in several Far Eastern countries.

A licence to manufacture the Folland Gnat single-seat light fighter for the Indian Air Force was acquired in September, 1956; and Hindustan Aircraft will also manufacture the Bristol Orpheus turbojet engine for the Gnat, under a licence agreement with Bristol Aero-Engines, Ltd. New factory buildings for these two projects are nearing completion and according to present expectations the first Indian-built Gnat and Orpheus engine will be completed in 1961.

At the same time plans have already been finalised and work is progressing on the development of an advanced jet trainer and a modern medium transport.



The Hindustan HT-2 Two-seat Primary Trainer (155 h.p. Cirrus Major III engine).



The Hindustan HT-2.

Hindustan Aircraft is recognised by the Directorate of Civil Aviation in India and has the approval of the American C.A.A. for the repair and overhaul of DC-3's, C-47's and Pratt & Whitney aero-engines. In addition to approval for DC-3 work, the company is an authorised DC-3 service centre of the Douglas Aircraft Company. Hindustan is also repair and service agent in India for the de Havilland companies.

The company's branch factory in Calcutta is continuing to concentrate on the repair and overhaul of DC-3's belonging to the Indian Airlines Corporation and non-scheduled operators. In addition, this branch factory will be equipped for the servicing, repair and overhaul of helicopters.

In addition to aircraft work, the factory is manufacturing railway coaches for the Indian Railways and omnibus body kits for the municipal authorities of most of the important cities in India.

The company's works in Bangalore are spread over an area of 1,100 acres, and the total personnel employed is over 11,000.



Two Hindustan HT-2 Trainers of the Indian Air Force.

THE HINDUSTAN HT-2.

TYPE.—Two-seat Primary Trainer.

WINGS.—Low-wing cantilever monoplane. Wing section NACA 23012. Aspect ratio 7.13. Dihedral 5.15 degrees. All-metal two-spar structure. All-metal split flaps. Area of ailerons (2) 14.35 sq. ft. (1.33 m.²). Total flap area 14.18 sq. ft. (1.31 m.²). Gross wing area 173.4 sq. ft. (16.0 m.²).

FUSELAGE. — All-metal semi-monocoque structure.

TAIL UNIT.—Cantilever monoplane type. All-metal structure. Areas: fin 9.34 sq. ft. (0.86 m.²), rudder 8.17 sq. ft. (0.75 m.²), tailplane 16.8 sq. ft. (1.58 m.²), elevators (2) 11.2 sq. ft. (1.05 m.²).

LANDING GEAR.—Fixed tail-wheel type. Hindustan oleo-pneumatic shock-absorber struts. Dunlop wheels and hydraulic single-disc type brakes. Track: 9 ft. (2.74 m.).

POWER PLANT.—One 155 h.p. Cirrus Major III four-cylinder in-line inverted air-cooled engine driving a two-blade fixed-pitch wood airscrew. Two fuel tanks in wings. Total fuel capacity 26 Imp. gallons (117 litres).

ACCOMMODATION.—Enclosed tandem cockpits with dual controls. Separate sliding sections over each cockpit. Full standard basic training equipment, night and blind flying training equipment, etc.

DIMENSIONS.—
Span 35 ft. 2 in. (10.72 m.).
Length 24 ft. 8.6 in. (7.53 m.).
Height 8 ft. 11 in. (2.74 m.).

WEIGHTS.—
Weight empty 1,540 lb. (702 kg.).
Weight loaded 2,240 lb. (1,018 kg.).

PERFORMANCE.—
Max. speed 130 m.p.h. (209 km.h.).
Cruising speed 115 m.p.h. (185 km.h.).
Stalling speed without flaps 52 m.p.h. (84 km.h.).
Initial rate of climb 800 ft./min. (244 m./min.).
Service ceiling 14,500 ft. (4,420 m.).
Absolute ceiling 16,500 ft. (5,060 m.).
Still air range 350 miles (560 km.).
Endurance at cruising speed 3.5 hours.

BULGARIA

LAZAROW

ENG. CWIETAN LAZAROW.

The first post-war aircraft of Bulgarian origin, the LAZ-7, was the work of Eng. Cwietan Lazarow, the Bulgarian designer who was responsible for the pre-war DAR aircraft and for the only nationally-designed wartime military aircraft, the DAR-10 light bomber of 1941. A brief description of the LAZ-7 is given below.

The basic LAZ-7 design has been developed progressively into a four-seat air-taxi and liaison aircraft, designated LAZ-8. An ambulance version of the LAZ-8, known as the LAZ-11, was also built, but only in prototype form.

Lazarow's latest fixed-wing design is a single-seat advanced trainer ; but nothing is known of this except that its cockpit is situated far back in the fuselage near the fin and that it has a wing span of 8 m. (26 ft. 3 in.).

Since 1953, Lazarow has also been engaged actively in helicopter studies and a brief description of his latest helicopter project, the LAZ-10H, appears hereafter.

THE LAZAROW LAZ-7.

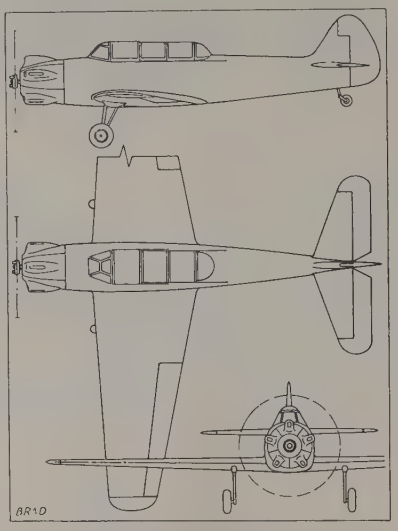
The LAZ-7 tandem two-seat sports and training monoplane was designed in 40 days to a specification issued by Yugoslavia in 1946. The prototype, powered by a 160 h.p. Walter Minor 6-III engine, won the eliminating trials in competition with its Yugoslav rival, the Aero 2S with a similar power plant.

WEIGHT.—
Weight loaded 927 kg. (2,044 lb.).

PERFORMANCE.—
Max. speed 240 km.h. (149 m.p.h.).
Cruising speed 215 km.h. (133.5 m.p.h.).
Landing speed 85-100 km.h. (53-62 m.p.h.).
Climb to 1,000 m. (3,280 ft.) 4 min. 47 sec.
Climb to 4,000 m. (13,120 ft.) 28 min. 39 sec.
Ceiling 5,250 m. (17,225 ft.).
Range 845 km. (525 miles).
Endurance 3 hr. 56 min.

THE LAZAROW LAZ-7M.

Following its success in the Yugoslav competition, the LAZ-7 was extensively redesigned. The new version, known as the LAZ-7M, is powered by a Russian 160 h.p. M-11FR five-cylinder air-cooled radial engine enclosed in a helmeted cowling and driving a Visch V-501 two-blade variable-pitch airscrew.



The Lazarow LAZ-7M.

It is an orthodox low-wing monoplane with fixed tail-wheel landing gear. The fuselage is of welded steel-tube construction, with wooden formers and fabric covering. Wings and tail surfaces are also of mixed wood and metal construction with fabric covering.

The LAZ-7M was put into production at the Bulgarian State Aircraft Works and is in service with the national flying clubs.

THE LAZAROW LAZ-8.

The LAZ-8 is a four-seat air taxi and liaison version of the Lazarow LAZ-7M described earlier. No further details are available.

THE LAZAROW LAZ-10H.

The LAZ-10H is a lightweight single-rotor helicopter, seating two side-by-side in an enclosed cabin. It is powered by two pulse-jet engines, mounted on the tips of the two-blade rotor. The rotor blades can be folded and the tail-boom removed for transport. Re-assembly of the helicopter takes ten minutes.

WEIGHTS (estimated).—
Weight empty 155 kg. (342 lb.).
Weight loaded 420 kg. (926 lb.).

PERFORMANCE (estimated).—
Max. speed 120 km.h. (74.5 m.p.h.).
Cruising speed 100 km.h. (62 m.p.h.).
Service ceiling 4,000 m. (13,125 ft.).
Hovering ceiling 1,200 m. (3,940 ft.).
Endurance 1 hr.

CHILE

FANAERO-CHILE

FÁBRICA NACIONAL DE AERONAVES (FANAERO-CHILE).

HEAD OFFICE : HUÉRFANOS 1202, PISO 4, SANTIAGO DE CHILE.

Directors : General de Brigada Aérea (R) don Edison Díaz Salvo (Chairman) ; Comandante de Escuadrilla (RS) don Juan Soler Manfredini (Managing Director) ; General don Eduardo Iensen Franke ; Coronel don Renato González Allendes ; Coronel don Alberto Honnywell Mendiluce ; don Francisco Javier Domíngues (Chief Engineer of the Production Development Corporation) ; don Renato Mujica Gómez (Manager of the Mortgage Department of the State Bank) ; Comandante de Excuadrilla don Carlos Dinator Espinosa (Fiscal Director) ; and don René Frías de Mendoza (Secretary).

The Fabrica Nacional de Aeronaves (Fanaero-Chile) was created under the laws of the Republic in June, 1953, as a national but self-administered enterprise to be responsible for the manufacture of certain types of aircraft, gliders, aircraft parts and other aeronautical equipment.

Fanaero-Chile has its headquarters in Santiago and will have its production facilities at Rancagua, Province of O'Higgins, some 43 miles from Santiago. Pending the construction of the necessary plant and hangars, which is being undertaken by the Production Development Corporation, Fanaero-Chile is temporarily using facilities on the "Los Cerrillos" Airport, Santiago.

At the present time, the company is engaged in the major overhaul of aircraft and in the manufacture of aircraft metal structures for which the necessary equipment has been installed in the workshops.

Recently, the company has undertaken the conversion of a number of military PBY-6A Catalina flying-boats into civil aircraft capable of accommodating 28 passengers. This work was done for a commercial airline company.



The Fanaero-Chile Chincol (215 h.p. Continental O-470-11 engine).

THE FANAERO-CHILE CHINCOL.

Designed by Ing. Alfredo Davins Ferrer, the prototype of the Chincol was first flown on December 14, 1955, and has completed successfully its test flight programme. A series of 50 Chincol trainers is being built for the Chilean Air Force. They have a safety factor of 9 for advanced aerobatic flying.

TYPE.—Two-seat Primary Military Trainer.

WINGS.—Cantilever low-wing monoplane. Wing section NACA 23015 (root), NACA 23009 (tip). Aspect ratio 6.8. Chord 1.9 m. (6 ft. 3 in.) at root, 1.15 m. (3 ft. 9 in.) at tip. Dihedral 6°. Incidence 2°. All-wood two-spar structure, plywood covered and with an outer fabric covering overall. Material used throughout is a Chilean wood known as Mañío. Removable wing-tips. All-wood slotted ailerons. Prototype has no flaps, but flaps will be fitted to production aircraft. Total aileron area 1.56 m.² (16.8 sq. ft.). Gross wing area 15.7 m.² (169 sq. ft.).

FUSELAGE.—Welded steel-tube structure, with frames of Mañío wood. Plywood-covered rear fuselage.

TAIL UNIT.—All-wood cantilever monoplane structure. Total area of vertical surfaces 1.15 m.² (12.37 sq. ft.). Total area of horizontal surfaces 2.77 m.² (29.81 sq. ft.).

LANDING GEAR.—Fixed tail-wheel type. Cantilever main units have rubber-in-compression shock-absorbers. Hydraulic brakes. Wheel track 2.30 m. (7 ft. 7 in.).

POWER PLANT.—One 215 h.p. Continental O-470-11 six-cylinder horizontally-opposed air-cooled engine.

DIMENSIONS.—
Span 10.40 m. (34 ft. 1 in.).
Length 7.22 m. (23 ft. 8 in.).
Height 2.10 m. (6 ft. 10 in.).

WEIGHTS.—
Weight empty 740 kg. (1,632 lb.).
Weight loaded 1,050 kg. (2,315 lb.).

PERFORMANCE.—
Max. speed at S/L. 210 km.h. (131 m.p.h.).
Cruising speed 185 km.h. (115 m.p.h.).
Stalling speed 90 km.h. (56 m.p.h.).
Rate of climb at S/L. 245 m./min. (805 ft./min.).
Service ceiling 5,400 m. (17,700 ft.).
Absolute ceiling 6,200 m. (20,340 ft.).
Take-off distance to 15 m. (50 ft.) 240 m. (787 ft.).
Landing distance from 15 m. (50 ft.) 340 m. (1,115 ft.).
Cruising radius 650 km. (404 miles).

CHINA

THE CHINESE PEOPLE'S REPUBLIC

STATE AIRCRAFT FACTORY.

MUKDEN.

Director: Professor Hsue Shen Tsien.

This State Factory is building both military and civil aircraft of Russian design for domestic use.

In current production for the Chinese Air Force is the MiG-17 single-seat fighter. The first Chinese-built MiG-17 was completed in 1956 and production is at the rate of 12-15 a month. Engines, radio, instruments and certain other items of equipment are imported from the U.S.S.R. which also supplies technical assistance.

The Antonov An-2 general purpose biplane is also being manufactured in series, the first aircraft off the production line having flown early in 1958. The Ash-62 engine and some items of equipment for this aircraft are being imported from the U.S.S.R. The An-2 will be used in China for crew training, for agricultural work and for aerial survey and photography, as well as for general transport and communications duties.

The Yak-18 two-seat trainer has for some time been assembled in China from components imported from Russia, although the M-11 FR engine with which it is powered is built under licence locally.

CZECHOSLOVAKIA

CESKOSLOVENSKÉ ZÁVODY LETECKÉ (Czechoslovak Aircraft Works).

HEAD OFFICE: PALACKÉHO NAM. 4, PRAGUE II.

Manager: Ladislav Hlavsa.

In this concern is grouped all the Czech aviation industry, including all factories engaged in the production of aircraft, aero-engines and airscrews.

In addition to the Czech-designed aircraft described and illustrated below, these factories are building several types of Soviet-designed aircraft, including the Ilyushin Il-28 light jet-bomber and the MiG series of jet-fighters.

Production of the MiG-15 has been completed and has been followed by production of the MiG-17 and the supersonic MiG-19.

The sale of all the aviation products as well as the information service are handled exclusively by:

OMNIPOL LIMITED, WASHINGTONOVA 11, PRAGUE III.



The C-11 Two-seat Trainer, the Czech-built version of the Russian Yak-11.

THE CS-102.

The initial version of the Soviet MiG-15 jet-fighter, as built in Czechoslovakia, was designated CS-102. It was powered by an RD-45F turbojet supplied from Soviet production.

THE S-103.

Under the designation of S-103, Czech factories have manufactured large numbers of MiG-15 fighters, powered by Czech-built Klimov VK-1 turbojets and incorporating design improvements compared with the CS-102. All components were built in Czechoslovakia.

Aircraft of this type were supplied to the Egyptian Air Force.

THE C-11.

C-11 is the designation of the Russian Yak-11 two-seat intermediate and advanced training aircraft built under licence in Czechoslovakia. Full details of this aircraft are given in the U.S.S.R. section of this work.



The C-11U, which is similar to the C-11 except for the landing-gear.

THE C-11U.

The C-11U is a Czech licence-built version of the Yak-11U, of which full details appear in the U.S.S.R. section. It is basically similar to the C-11, but has a nose-wheel landing-gear.



The Tom-8 Two-seat Trainer (235 h.p. M-208C engine).

THE TOM-8 (L-208).

TYPE.—Two-seat Training monoplane.

WINGS.—Cantilever low-wing monoplane. NACA 63 series wing section. Aspect ratio 6.94. Chord at root 2.2 m. (7 ft. 2½ in.), at tips 1.0 m. (3 ft. 3 in.). Dihedral on centre-section —25′, on outer wing 6.5°. Incidence 2° 30′. All-metal structure. Centre-section integral with fuselage. Two-spar outer wings attached to centre-section through three hinges. Statically and aerodynamically balanced Frise-type ailerons of metal construction with fabric covering. Ground-adjustable trim/balance tab on each aileron. Split flaps in four sections, operated electro-hydraulically. Total area of ailerons 1.318 m.² (14.18 sq. ft.). Total area of flaps 3.838 m.² (41.31 sq. ft.). Wing area 17.255 m.² (185.7 sq. ft.).

FUSELAGE. — All - metal semi - monocoque structure.

TAIL UNIT.—Cantilever monoplane type. All-metal structure. Elevators and rudder fabric-covered. Controllable trim-tab in port elevator; ground-adjustable balance

tab in starboard elevator. Controllable trim-tab in rudder. Areas: fin 0.84 m.² (9.04 sq. ft.), rudder 1.10 m.² (11.84 sq. ft.), tailplane 2.114 m.² (22.75 sq. ft.), elevators 1.134 m.² (12.2 sq. ft.). Tailplane span 3.86 m. (12 ft. 8 in.).

LANDING GEAR.—Retractable tricycle type. Hydraulic actuation. Oleo-pneumatic shock-absorbers. Hydraulic brakes. Nose-wheel 420×150 mm. Wheel track 2.64 m. (8 ft. 8 in.). Wheelbase 2.46 m. (8 ft. 1 in.).

POWER PLANT.—One 235 h.p. M-208C six-cylinder horizontally-opposed air-cooled engine, driving two-blade metal variable-pitch airscrew, diameter 2.4 m. (7 ft. 10 in.) with electro-automatic or manual control. Fuel in two tanks in centre-section with total capacity of 180 litres (39.6 Imp. gallons). Small auxiliary tank permits inverted flight for one minute.

ACCOMMODATION.—Crew of two in tandem cockpits, with instructor to rear. Separate canopies hinge upwards to starboard and are jettisonable. Complete dual controls and instruments.

DIMENSIONS.—Span 10.93 m. (35 ft. 10 in.).
Length 9.37 m. (30 ft. 9 in.).
Height 3.17 m. (10 ft. 5 in.).

WEIGHTS AND LOADINGS.—
Weight empty 1,060 kg. (2,337 lb.).
Weight loaded (normal) 1,380 kg. (3,042 lb.).
Weight loaded (aerobatic) 1,300 kg. (2,866 lb.).
Wing loading (normal) 80 kg./m.² (16.39 lb./sq. ft.).
Power loading (normal) 5.89 kg./h.p. (12.98 lb./h.p.).

PERFORMANCE.—
Max. speed 285 km.h. (177 m.p.h.).
Cruising speed at 1,000 m. (3,280 ft.) 240 km.h. (149 m.p.h.).
Landing speed 100 km.h. (62 m.p.h.).
Rate of climb at S/L. 325 m./min. (1,065 ft./min.).
Service ceiling 6,050 m. (19,850 ft.).
Range 720 km. (447 miles).
Endurance 3 hours.

THE L-60 BRIGADYR.

The L-60 is a light three-seat or four-seat all-metal monoplane suitable for a wide variety of duties. About 50 had been built by mid-1957.

The military version can be used for liaison, air ambulance work, decontamination, parachute jumping, aerial photography, bombing and other duties.

The civil version is being produced as a light four-seat transport or sporting aircraft, which can be used also as a primary trainer or for glider-towing. It is easily adapted to carry two stretcher cases and a medical attendant, in addition to the pilot.

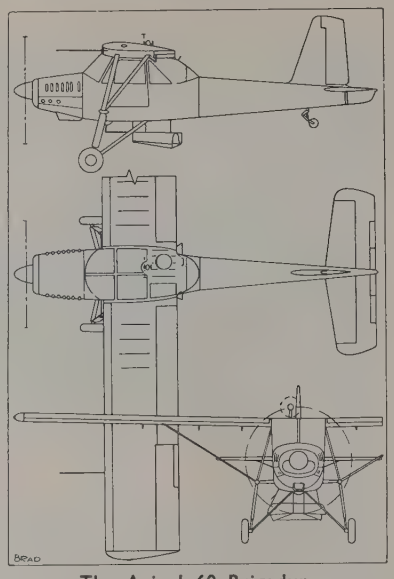
For agricultural duties, the L-60 can be equipped for normal farm and forest pest control operations with spray or gas, for decontamination of contaminated areas, top-dressing, seed-sowing, forest fire patrol and fire-fighting, and other tasks.

TYPE.—Light General Purpose monoplane.

WINGS.—High-wing strut-braced monoplane. NACA 4412 wing section. Aspect ratio 8.07. Dihedral 1° 30′. Incidence 3°. Constant chord all-metal two-spar structure with fabric covering between the spars.



The Civil L-60 Brigadyr (220 h.p. Praga Doris M-208B engine).



The Avia L-60 Brigadyr.

Frise-type ailerons with metal structure and fabric covering, part-balanced statically and aerodynamically. Double-slotted flaps with metal structure and fabric covering are interconnected with the ailerons and leading-edge slots, except on agricultural version which has fixed slots. Flaps and slots are electrically actuated. Up and down movement of ailerons with flaps locked is 30° and 20° respectively. From the 15° down take-off position of the wing flaps, the ailerons are moved so that they are 15° down when the flaps are 50° down. Total area of ailerons 2.46 m.² (26.5 sq. ft.). Total area of flaps 4.042 m.² (43.5 sq. ft.). Wing area 24.30 m.² (261.6 sq. ft.).

FUSELAGE.—All-metal monocoque construction.

TAIL UNIT.—All-metal cantilever monoplane structure, with the fin forming an integral part of the fuselage. Metal-covered variable-incidence tailplane (range 3° up, 5° down). Fabric-covered elevators and rudder are statically and dynamically balanced. Elevators fitted with two outer balance tabs and two inner trim-tabs which are operated by the pilot and linked automatically with the tailplane. Areas: fin 0.761 m.² (8.19 sq. ft.), rudder 0.96 m.² (10.33 sq. ft.), tailplane 1.964 m.² (21.14 sq. ft.), elevators 2.796 m.² (30.09 sq. ft.).

LANDING GEAR.—Fixed tail-wheel type. Oleo-pneumatic shock absorber struts on main and tail wheels. Low pressure tyres diameter 500 × 180 mm. on main wheels and 260×85 mm. on tail-wheel. Hydraulic brakes. Wheel track 3.0 m. (9 ft. 10 in.). Wheelbase 5.60 m. (18 ft. 4 in.).

POWER PLANT.—One Praga Doris M-208B "flat" six-cylinder air-cooled engine rated at 220 h.p. for take-off at 3,000 r.p.m., with a nominal power of 200 h.p. at 2,900 r.p.m. and a cruising power of 180 h.p. at 2,800 r.p.m. Two-bladed metal controllable-pitch Type V-415 airscrew or two-bladed wooden controllable-pitch Type V-411 airscrew with a pitch range of 18 degrees is manually-controlled. Diameter of airscrew 2.7 m. (8 ft. 10 in.). Fuel in four wing tanks with total capacity of 200 litres (44 Imp. gallons).

ACCOMMODATION (Military version).—Crew of three, pilot, wireless-operator and rear-gunner, on two side-by-side front seats and a single rear seat. Dual controls can be fitted.

ACCOMMODATION (Civil version).—Four seats in two pairs. The rear portion of the canopy hinges down for easy loading and unloading of two stretchers in air ambulance version, which has also a seat for a medical attendent in the rear of the cabin.

EQUIPMENT (Military version).—Type RSI-6 and RPKO-10 radio sets. One machine-gun. Blind-flying equipment for night operations.

EQUIPMENT (Agricultural version).—Can have either 420-litre (92 Imp. gallon) tank for chemicals and spray-bars, or hopper for 300 kg. (660 lb.) of dust. Dusting and spraying equipment is driven mechanically from the engine under control of pilot. Dispersion rate for oil spraying 5-12 litres (1-2.64 Imp. gallons) per hour; for water spraying 50-300 litres (11-66 Imp. gallons) per hour; for dust 5-300 kg. (11-660 lb.) per hour.

DIMENSIONS.—
Span 13.96 m. (45 ft. 9½ in.).
Length 8.54 m. (28 ft.).
Height 2.72 m. (8 ft. 11 in.).

WEIGHTS AND LOADINGS.—
Weight empty 955 kg. (2,105 lb.).
Normal weight loaded 1,415 kg. (3,120 lb.).
Max. permissible loaded weight 1,560 kg. (3,439 lb.).
Wing loading 58.4 kg./m.² (11.96 lb./sq. ft.).
Power loading 6.4 kg./h.p. (14.1 lb./h.p.).

PERFORMANCE.—
Max. speed 193 km.h. (120 m.p.h.).
Cruising speed at S/L. 175 km.h. (109 m.p.h.).
Stalling speed 52 km.h. (32 m.p.h.).
Service ceiling 4,500 m. (14,765 ft.).
Climb to 1,000 m. (3,280 ft.) 4.3 min.
Climb to 3,000 m. (9,850 ft.) 17.5 min.
Take-off run from grass to clear 15 m. (50 ft.) 225 m. (740 ft.).
Landing run on grass from 15 m. (50 ft.) 195 m. (640 ft.).
Range at 1,000 m. (3,280 ft.) 720 km. (447 miles).
Fuel consumption at cruising speed 48 litres/hr. (10.56 gal./hr.).



The military L-60 Brigadyr (220 h.p. Praga Doris M-208B engine).

THE LD-40 META-SOKOL.

The prototype LD-40 Meta-Sokol with M332 supercharged engine completed its

flight tests in March, 1956. It has a "reversed tricycle" landing-gear, in which the retractable tailwheel is mounted under the rear of the cabin and keeps the fuselage almost horizontal on the ground.

A 105 h.p. Walter Minor 4-III engine can be fitted as an alternative to the M332, the two engines being dimensionally interchangeable.

The following details apply to the standard M332-powered version :—

TYPE.—Four-seat Light Training and Sporting aircraft.

WINGS.—Low-wing cantilever monoplane. Be. 1120 wing section. Aspect ratio 6.9. Thickness/chord ratio 15.7% at root, 10% at tips. Dihedral 6.5° on outer wings only. Incidence 2°. All metal structure. Centre-section integral with fuselage. Two-spar outer panels attached to centre-section through three hinges. Interchangeable metal ailerons are fabric-covered. Mechanically-operated all-metal split flaps on outer wings. Fixed trim tab on one side only. Total area of ailerons 0.98 m.² (10.55 sq. ft.). Total area of flaps 1.47 m.² (15.82 sq. ft.). Wing area 14.5 m.² (156 sq. ft.).

FUSELAGE.—All-metal monocoque structure.

TAIL UNIT.—All-metal cantilever monoplane structure. Variable-incidence metal-covered tailplane (range 1.5° up, 8° down). Statically-balanced fabric-covered elevators and rudder are structurally identical. Areas : fin 0.715 m.² (7.69 sq. ft.), rudder 0.585 m.² (6.29 sq. ft.), tailplane 2.6 m.² (27.99 sq. ft.), elevators 1.17 m.² (12.59 sq. ft.). Tailplane span 2.99 m. (9 ft. 10 in.).

LANDING GEAR.—Retractable "reversed tricycle" type, with main wheels retracting backward into the wings and tail-wheel into the fuselage under rear of cabin. Oleo-pneumatic shock-absorbers. Main wheels with 420 × 150 mm. tyres protrude slightly in retracted position to reduce damage to aircraft in belly landing. Tail-wheel tyre 290 × 110 mm. Mechanical brakes. Wheel track 1.88 m. (6 ft. 2 in.). Wheelbase 2.04 m. (6 ft. 8 in.).

POWER PLANT.—One Walter M332 four-cylinder in-line inverted air-cooled supercharged engine, giving take-off power of 140 h.p. at 2,700 r.p.m., rated power of 115 h.p. at 2,500 r.p.m. and cruising power of 100 h.p. at 2,400 r.p.m. Two-blade Type V-410 metal three-position variable-pitch airscrew, diameter 1.90 m. (6 ft. 3 in.). Two fuel tanks in wing leading-edges, with total capacity of 110 litres (24.2 Imp. gallons). Oil capacity 10 litres (2.2 Imp. gallons).

ACCOMMODATION.—Enclosed cabin for four persons in two pairs, with separate front seats and bench-type rear seat. Rearward-sliding canopy. Luggage compartment accessible from cabin.

DIMENSIONS.—
Span 10.0 m. (32 ft. 9½ in.).
Length 7.56 m. (24 ft. 9½ in.).
Height 2.47 m. (8 ft. 1 in.).

WEIGHTS AND LOADINGS.—
Weight empty 520 kg. (1,146 lb.).
Useful load 395 kg. (871 lb.).
Weight loaded 920 kg. (2,028 lb.).
Wing loading 63.5 kg./m.² (13.0 lb./sq. ft.).
Power loading 6.6 kg./h.p. (14.55 lb./h.p.).

PERFORMANCE.—
Max. speed 250 km.h. (155 m.p.h.).
Cruising speed 220 km.h. (137 m.p.h.).
Landing speed 88 km.h. (55 m.p.h.).
Rate of climb at S/L. 270 m./min. (885 ft./min.).
Service ceiling 5,000 m. (16,400 ft.).
Take-off on grass, zero wind 190 m. (625 ft.).
Landing on grass, zero wind 190 m. (625 ft.).
Range 850 km. (530 miles).
Max. endurance 5.5 hours.



The LD-40 Meta-Sokol (140 h.p. Walter M332 engine).

THE ZLIN 226T.

The Zlin 226 was developed from the Zlin 26/126 Series when the more powerful Walter Minor 6-III engine became available. The original Z-26 Trener 1 was in quantity production between 1948 and 1952, and was followed by the Z-126 Trener 2, production of which terminated at the end of 1955. The basic design was then re-worked to incorporate the 160 h.p. Walter Minor 6-III engine and a new aircraft, designated Z-226B Bohatyr (Hero), was the result.

The Zlin-226B was developed originally as a glider-tug, but a standard trainer version, the Zlin 226T Trener 6, was soon evolved and put into production. A Trener 6 won the International Aerobatic Championship at Coventry, England, in 1956.

A special single-seat aerobatic version, the Zlin 226A Akrobat, was produced in 1957.



The Zlin 226T Two-seat Trainer (160 h.p. Walter Minor 6-III engine).

The following description applies mainly to the Zlin 226T Trener 6.

TYPE.—Two-seat basic Trainer.

WINGS.—Low-wing cantilever monoplane. All-metal two-spar structure with flush-riveted light alloy stressed skin. Electrically-actuated flaps inboard of ailerons. Gross wing area 14.9 m.² (160.38 sq. ft.).

FUSELAGE.—Welded steel tube structure, upper and lower surfaces covered with easily-removable metal panels and remainder with fabric.

TAIL UNIT.—Cantilever monoplane type. All-metal structure. Removable tailplane and fin. Controllable trim-tab in elevator.

LANDING GEAR.—Fixed tail-wheel type. Cantilever oleo-pneumatic shock-absorbers attached to front steel centre-section spar which is welded to fuselage. Single-disc mechanical brakes actuated from both cockpits. Fully-castoring self-centering tail-wheel, steerable to 30° either side of centre-line.

POWER PLANT.—One 160 h.p. Walter Minor 6-III six-cylinder in-line inverted air-cooled engine driving a two-blade fixed-pitch wooden airscrew which varies in design for each version of aircraft. Fuel in two main wing tanks, each with capacity of 35 litres (7.7 Imp. gallons) and (Z.226B only) on 45 litre (9.9 Imp. gallons) auxiliary tank. System designed to permit inverted flying for 5 minutes.

ACCOMMODATION.—Tandem seats under continuous sliding canopy which is jettisonable in an emergency. Windscreen frame reinforced as crash pylon. Complete dual controls and instrumentation. Full standard blind-flying panels. Radio and intercomm. Adjustable seats and rudder pedals in both cockpits. Seat cushions may be replaced by seat type parachutes.

DIMENSIONS.—
Span 10.28 m. (33 ft. 9 in.).
Length 7.80 m. (25 ft. 7 in.).
Height 2.06 m. (6 ft. 9 in.).

WEIGHTS AND LOADINGS.—
Weight empty 570 kg. (1,257 lb.).
Normal loaded weight 728 kg. (1,605 lb.).
Max. loaded weight 818 kg. (1,803 lb.).
Wing loading 48.9 kg./m.² (10.02 lb./sq. ft.).
Power loading 4.55 kg./h.p. (10.03 lb./h.p.).

PERFORMANCE (at A.U.W. of 818 kg.= 1,803 lb.).—
Max. speed 235 km.h. (146 m.p.h.).
Cruising speed 195 km.h. (121 m.p.h.).
Landing speed 75 km.h. (46.5 m.p.h.).
Rate of climb at S/L. 300 m./min. (984 ft./min.).
Service ceiling 5,500 m. (18,040 ft.).
Take-off distance from grass 140 m. (460 ft.).
Landing distance 110 m. (360 ft.).
Range 480 km. (300 miles).
Fuel consumption at cruising speed 32.5 litres/hr. (7.15 Imp. gallons/hr.).

THE ZLIN 326 TRENER-MASTER.

The Zlin 326 Trener Master two-seat basic trainer which was flown for the first time in the Autumn of 1957, is a further development of the Zlin 26/126/226 Series with retractable landing gear and other refinements. Details are generally as for the Zlin 226 except for the following changes :—

LANDING GEAR.—Retractable tail-wheel type. Electrically-operated retraction system. Hydraulic shock-absorbers. Main wheels retract backward into wings. Tyres protrude in retracted position to reduce damage in event of wheels-up landing.



The Zlin 226A Akrobat (160 h.p. Walter Minor 6-III engine).



The Super Aero 45 Cabin Monoplane (two 105 h.p. Walter Minor 4-III engines).

DIMENSIONS.—
As for Zlin 226 except:
Span 10.58 m. (34 ft. 9 in.).
Wing area 15.5 m.² (166.8 sq. ft.).
WEIGHTS.—
Weight empty 635 kg. (1,400 lb.).
Weight loaded 900 kg. (1,984 lb.).
PERFORMANCE.—
Max. speed 245 km.h. (152 m.p.h.).
Service ceiling 4,800 m. (15,750 ft.).
Take-off run 250 m. (820 ft.).
Range 650 km. (403 miles).

THE AERO L-200 MORAVA.

This twin-engined business aircraft made its first flight on April 8, 1957, and is now in production in the National Aircraft Works at Kumovice. Like the Super Aero, it was designed by Ladislav Smrcek.

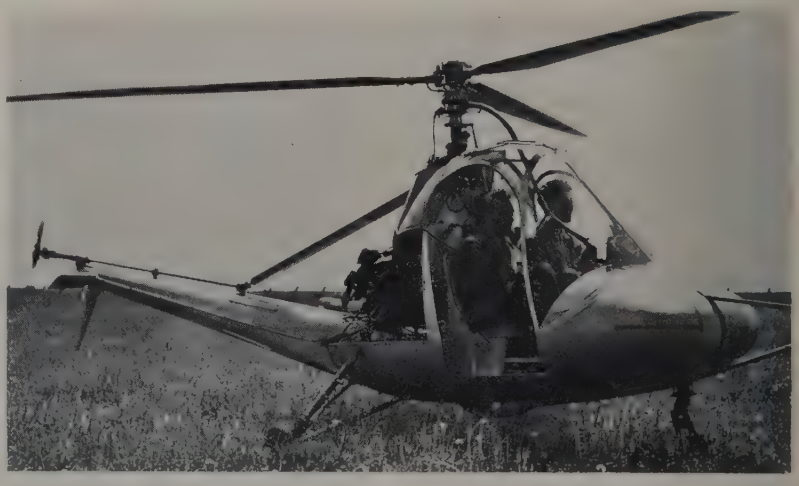
TYPE.—Twin-engined light business aircraft.
WINGS.—Cantilever low-wing monoplane. Dihedral 6°. All-metal two-spar structure. Frise-type ailerons. High-lift flaps. Warm air de-icing of leading-edge.
FUSELAGE.—All-metal semi-monocoque structure.
TAIL UNIT.—Cantilever monoplane type with twin fins and rudders. All-metal structure. Trim-tabs in elevator and both rudders.
LANDING GEAR.—Retractable tricycle type. Electric retraction. Brakes on main wheels. Steerable nose-wheel.
POWER PLANT.—Two 160 h.p. Walter Minor 6-III six-cylinder in-line inverted air-cooled engines, driving two-blade metal fully-feathering variable-pitch Type V-406 airscrews, diameter 1.9 m. (6 ft. 2½ in.). Fuel in wing-tip tanks and auxiliary tanks in wings outboard of engines.
ACCOMMODATION.—Four to five persons on two individual front seats and bench-type rear seat, 1.3 m. (4 ft. 3 in.) wide. Dual controls. Provision for night and blind-flying instrumentation. Entry through forward-opening door on each side of cabin.
DIMENSIONS.—
Span 12.0 m. (39 ft. 4 in.).
Length 8.4 m. (27 ft. 6 in.).
Height 2.25 m. (7 ft. 4 in.).
WEIGHTS.—
Weight empty 1,125 kg. (2,480 lb.).
Weight loaded 1,850 kg. (4,079 lb.).
PERFORMANCE.—
Max. speed 300 km.h. (186 m.p.h.).
Cruising speed 260 km.h. (162 m.p.h.).
Landing speed 105 km.h. (65 m.p.h.).
Range 1,600 km. (995 miles).

THE SUPER AERO.

TYPE.—Twin-engined 4/5-seat air taxi (ICAO category D).
WINGS.—Cantilever low-wing monoplane. Aero No. 58-64 wing section. Dihedral on outer wings 6°. Incidence 2°. All-metal two-spar structure. I-section spars. Statically and dynamically-balanced ailerons have metal frames and fabric covering. Electrically-operated all-metal split trailing-edge flaps in two sections each side. Total area of ailerons 1.084 m.² (11.67 sq. ft.). Total area of flaps 2.392 m.² (25.75 sq. ft.). Wing area 17.1 m.² (184 sq. ft.).
FUSELAGE.—Metal semi-monocoque structure. Nose section hinged for access to controls and battery.
TAIL UNIT.—All-metal cantilever monoplane type. Fin integral with fuselage. Fixed surfaces metal-covered. Statically and dynamically-balanced rudder and elevators have metal frames and fabric covering. Controllable trim-tabs in rudder and elevators. Areas: fin 0.68 m.² (7.32 sq. ft.), rudder 0.95 m.² (10.23 sq. ft.), tailplane 2.03 m.² (21.85 sq. ft.), elevators 1.30 m.² (13.99 sq. ft.). Tailplane span 3.39 m. (11 ft. 1½ in.).
LANDING GEAR.—Retractable two-wheel type. Oleo-pneumatic shock-absorbers. Electrical operation, with emergency mechanical gear. Low-pressure tyres, 500 × 180 mm., and hydraulically-operated brakes. Steerable tail-wheel, with oleo-pneumatic shock-absorber, 260 × 85 mm., linked with rudder control. Wheels can be replaced by skis or floats. Wheel track 2.9 m. (9 ft. 6 in.). Wheelbase 4.995 m. (16 ft. 5 in.).
POWER PLANT.—Two 105 h.p. Walter Minor 4-III four-cylinder in-line inverted air-cooled engines. Two-blade Type V-405 or V-406 metal four-position variable-pitch airscrews or two-blade Type V-401E wooden four-position variable-pitch airscrews, diameter 1.8 m. (5 ft. 11 in.). Fuel capacity 324 litres (71 Imp. gallons) in four wing tanks. Two oil tanks, each with capacity of 8.5 litres (1.87 Imp. gallons), behind engines. Hand and electric starter.
ACCOMMODATION.—Enclosed cabin seating pilot (on port) and one passenger side-by-side with single or dual controls, and two or three passengers behind on full-width seat. Access door on port side hinges upwards. Front seats adjustable. Cabin heat and sound proofed and ventilated; if desired, also heated. Large luggage compartment behind rear seats. Flight and blind flying instruments. Complete electric equipment. Radio, if desired.
DIMENSIONS.—
Span 12.25 m. (40 ft. 2½ in.).
Length 7.77 m. (25 ft. 6 in.).
Height 2.30 m. (7 ft. 6 in.).
WEIGHTS AND LOADINGS.—
Weight empty 960 kg. (2,116 lb.).
Crew 310 kg. (684 lb.).
Fuel (174 litres = 38.25 Imp. gallons) 124 kg. (273 lb.).
Oil 15 kg. (33 lb.).
Luggage and radio 91 kg. (200 lb.).
Weight loaded (normal) 1,500 kg. (3,306 lb.).
Weight loaded (full fuel) 1,600 kg. (3,527 lb.).
Wing loading (normal) 87.8 kg./m.² (18.0 lb./sq. ft.).
Power loading (normal) 7.1 kg./h.p. (15.7 lb./h.p.).
PERFORMANCE (at A.U.W. of 1,600 kg. = 3,527 lb.).—
Max. speed 275 km.h. (171 m.p.h.).
Cruising speed (75% power) 230 km.h. (143 m.p.h.).
Landing speed 100 km.h. (62 m.p.h.).
Initial rate of climb 252 m./min. (825 ft./min.).
Service ceiling 5,000 m. (16,400 ft.).
Theoretical ceiling on one engine 1,100 m. (3,600 ft.).
Take-off run from grass (with flaps) to clear 50 ft. (15.25 m.) 565 m. (1,855 ft.).
Landing distance (with flaps) from 50 ft. (15.25 m.) 395 m. (1,295 ft.).
Landing run, with flaps and brakes 225 m. (740 ft.).
Range 1,600 km. (995 miles).
Fuel consumption at cruising speed 48 litres/hour (10.5 Imp. gallons/hour).

THE AVIA-14.

The Avia-14 is the Czech-built version of the Russian Ilyushin Il-14 twin-engined medium-range airliner. It is structurally similar to the Il-14 of which a detailed description appears in the German section of this work, and its all-metal airframe is built mainly of D 16 duralumin.



The HC-2 Heli-Baby Light Helicopter (83 h.p. Praga DH engine).

The cabin is ventilated and heated, but not pressurised. It provides standard seating for a crew of three and 32 passengers; but a 36-passenger version is being developed. In addition a long-range de luxe 13-passenger V.I.P. transport version is available with individual cabins containing tables and settees as well as normal seats. A freighter version will be available towards the end of 1958.

Standard M-82T (ASh-82T) fourteen-cylinder two-row radial engines are fitted, as in the Russian and East German versions; but the Avia-14 has a greater payload and loaded weight than the original Il-14.

DIMENSIONS.—
Span 31.7 m. (104 ft. 0 in.).
Length 22.3 m. (73 ft. 2 in.).
Height 7.8 m. (25 ft. 7 in.).

WEIGHTS AND LOADINGS (32-seat version).—
Weight empty 12,600 kg. (27,778 lb.).
Design loaded weight 17,500 kg. (38,580 lb.).
Overload weight 18,000 kg. (39,683 lb.).
Max. landing weight 17,300 kg. (38,140 lb.).
Wing loading at design loaded weight 175 kg./m.² (35.8 lb./sq. ft.).
Power loading 4.6 kg./h.p. (10.1 lb./h.p.).

PERFORMANCE.—
Max. speed at 2,250 m. (7,400 ft.) 412 km.h. (256 m.p.h.).
Economic cruising speed at 2,000 m. (6,500 ft.) 320 km.h. (200 m.p.h.).
Rate of climb at S/L 365 m./min. (1,200 ft./min.).
Time to 1,000 m. (3,280 ft.) 3.2 min.
Service ceiling 6,700 m. (22,000 ft.).
Service ceiling on one engine 2,450 m. (8,000 ft.).
Take-off run 500 m. (1,640 ft.).
Take-off distance to 15 m. (50 ft.) 955 m. (3,135 ft.).
Landing run 450 m. (1,475 ft.).
Landing distance from 15 m. (50 ft.) 830 m. (2,725 ft.).
Range with max. payload (3,350 kg.= 7,385 lb.) 1,000 km. (620 miles).
Range with 2,150 kg. (4,740 lb.) payload 2,400 km. (1,490 miles).
Range of V.I.P. version, with wingtip tanks 4,000 km. (2,485 miles).

THE AERO HC-3.

The Aero HC-3 is a new six-seat helicopter, powered by a 240 h.p. piston-engine which drives a single main rotor. No other details were available at the time of writing.

THE HC-2 HELI-BABY.

It has been announced officially that 200 HC-2 helicopters are being built for domestic use and export.

TYPE.—Two-seat Light general-purpose helicopter.

ROTOR SYSTEM.—Three-blade main rotor and two-blade anti-torque tail rotor. Main rotor blades of wooden construction with a steel insert in leading-edge for mass balance and plywood covering armoured with fiberglas. NACA 23015 aerofoil section. Blades fully articulated in flapping and drag planes. Single adjustable friction damper for all three drag hinges. Blades mounted on tubular steel spars incorporating tension-torsion bars. Cyclic pitch change actuated by control stick. Collective pitch lever synchronised with engine throttle. Override settings of throttle by means of twist-grip on pitch control lever. Individually-flapping tail rotor blades of laminated wood with fiberglas covering. Pitch of tail rotor controlled by rudder pedals. Additional horizontal tail surface used during transition from vertical to horizontal flight.

FUSELAGE.—All-metal semi-monocoque structure, with non-stressed cabin enclosure.

LANDING GEAR.—Fixed tricycle type, with castoring nose-wheel capable of swivelling through 360°. Oleo-pneumatic shock-absorbers on all three wheels. All wheels size 260 × 85 mm. Tail-skid to avoid damage to rotor.

POWER PLANT.—One 83 h.p. Praga DH four-cylinder horizontally-opposed fan-cooled engine mounted aft of rotor pylon, with crankshaft centre-line inclined at 45°. Drive from engine taken through centrifugal clutch to main gearbox. Free-wheel in main gearbox for autorotation. Tail rotor driven off main gearbox through universal joint and shafting. Engine/main rotor r.p.m. ratio approximately 10 : 1. Engine/tail rotor r.p.m. ratio approximately 3 : 2. Normal fuel capacity 40 litres (8.8 Imp. gallons). Oil capacity 8 litres (1.76 Imp. gallons).

ACCOMMODATION.—Side-by-side seating for two in cabin with Plexiglas canopy. No doors. Dual overhead cyclic control stick. Collective pitch levers on left side of each seat. Starboard controls quickly removable. Cargo or special equipment space at centre of gravity.

DIMENSIONS.—
Diameter of main rotor 8.80 m. (28 ft. 10 in.).
Diameter of tail rotor 1.30 m. (4 ft. 3 in.).
Overall length 10.47 m. (34 ft. 4 in.).
Overall height 2.55 m. (8 ft. 4 in.).
Overall width 7.90 m. (25 ft. 11 in.).

WEIGHTS.—
Weight empty 380 kg. (838 lb.).
Weight loaded 580 kg. (1,279 lb.).

PERFORMANCE.—
Max. speed 126 km.h. (78 m.p.h.).
Cruising speed 100 km.h. (62 m.p.h.).
Rate of climb at S/L. 215 m./min. (705 ft./min.).
Service ceiling 3,030 m. (9,940 ft.).
Hovering ceiling in ground effect 1,100 m. (3,600 ft.).
Range 150 km. (93 miles).



The HC-2 Heli-Baby Light Helicopter (83 h.p. Praga DH engine).

THE L-13 BLANÍK.

The tandem two-seat L-13 sailplane is designed for training in all categories from elementary to "blind" flying, and for high-performance flight. Fully-aerobatic when flown solo. The prototype completed its flight testing in March, 1956.

WINGS.—Cantilever shoulder-wing monoplane, with 5° forward sweep at quarter-chord. Wing section NACA 63²A 615 at root, NACA 63²A 612 at tip. Aspect ratio 13.7. Chord 1.65 m. (5 ft. 5 in.) at root, 0.70 m. (2 ft. 3½ in.) at tip. Dihedral 3°. Incidence 4° at root, 1° at tip. All-metal two-spar structure attached to fuselage at three points. Main spar at 40% chord forms torsion-box with leading-edge. Wing-tip "salmons". Slotted area-increasing flaps. Metal spoilers connected with wheel-brake. Flaps and ailerons fabric-covered. Total area of ailerons 2.31 m.² (24.87 sq. ft.). Total area of flaps 3.95 m.² (42.52 sq. ft.). Total area of spoilers 0.65 m.² (7 sq. ft.). Wing area 19.15 m.² (206.13 sq. ft.).

FUSELAGE. — All-metal semi-monocoque structure of oval cross-section.

TAIL UNIT.—Cantilever monoplane type. All-metal structure. Elevator and rudder fabric-covered. Controllable trim-tab in elevator. Horizontal surfaces fold upwards parallel to rudder for transport. Areas: fin 0.71 m.² (7.64 sq. ft.), rudder 0.91 m.² (9.80 sq. ft.), tailplane 1.56 m.² (16.79 sq. ft.), elevators 1.11 m.² (11.95 sq. ft.).

LANDING GEAR.—Mechanically-retractable main wheel, size 350 × 135 mm., on centre-line of fuselage, with oleo-pneumatic shock-absorber and mechanically-actuated brake. Fully-castoring tail-wheel cushioned by rubber shock-absorber and centred by spring.

ACCOMMODATION.—Two seats in tandem in part-upholstered cabin, with heat-insulated walls. Hinged transparent canopy. Complete navigation instruments. Can have electrical horizon, directional gyro, radio and lighting.

DIMENSIONS.—
Span 16.20 m. (53 ft. 2 in.).
Length 8.40 m. (27 ft. 6½ in.).
Height 2.09 m. (6 ft. 10 in.).

WEIGHTS AND LOADINGS.—
Weight empty 280 kg. (617 lb.).
Normal loaded weight 470 kg. (1,036 lb.).
Max. loaded weight 500 kg. (1,102 lb.).
Normal wing loading 24.5 kg./m.² (5.02 lb./sq. ft.).
Max. wing loading 26.1 kg./m.² (5.35 lb./sq. ft.).

PERFORMANCE (at A.U.W. of 500 kg.=1,102 lb.).—
Max. gliding ratio at 89 km.h. (55 m.p.h.) 1 : 29.5
Min. rate of descent at 80 km.h. (50 m.p.h.) 0.78 m./sec. (2.56 ft./sec.).
Min. speed (flaps up) 66 km.h. (41 m.p.h.).
Min. speed (flaps down) 54 km.h. (33.5 m.p.h.).
Max. diving speed 240 km.h. (149 m.p.h.).
Max. permissible winch-launching speed 100 km.h. (62 m.p.h.).
Max. permissible aero-tow speed 140 km.h. (87 m.p.h.).
Ultimate load factor 8.



The L-13 Blaník Two-seat Multi-Purpose Sailplane.

EGYPT

(UNITED ARAB REPUBLIC)

STATE AIRCRAFT FACTORY

HEAD OFFICE AND WORKS : HELIOPOLIS.
General Mananger : I. Dia El Din Taha.

The Heliopolis aircraft factory forms part of the Military Factories Directorate. It was founded in 1950 and is producing a version of the wartime German Bücker Bu 181D Bestmann training monoplane under the name of Gomhouria. An initial batch of the Mk. 1 version powered by a 105 h.p. Walter Minor four-cylinder in-line inverted air-cooled engine was built for the Egyptian Air Forces. The Mk. 2 is basically similar but is re-engined with the 145 h.p. Continental C145 six-cylinder horizontally-opposed engine.

The Gomhouria Mk. 2 has been supplied to civil flying institutes, the Royal Jordanian Air Force, Sudan and Saudi Arabia. The description below applies to the Mk. 2 version.

THE GOMHOURIA (REPUBLIC).

TYPE.—Two-seat Trainer.

WINGS.—Low-wing cantilever monoplane. Wing section NACA 23017 at root, NACA 4412 at tip. Aspect ratio 8.3. Chord 1.8 m. (5 ft. 11 in.) at root, 0.63 m. (2 ft. 1 in.) at tip. Dihedral 5.5°. Incidence 4° at root. Two-spar all-wood structure. Frise-type fabric-covered ailerons. Split flaps of metal construction inboard of ailerons. Total area of ailerons 3.30 m.² (36.1 sq. ft.). Total flap area 2.56 m.² (27.5 sq. ft.). Gross wing area 13.5 m.² (145.3 sq. ft.).

FUSELAGE.—Front section is a welded steel tube structure, rear section a wooden monocoque.

TAIL UNIT.—Cantilever monoplane type. Wood frames with fixed surfaces plywood-covered and control surfaces fabric covered. Areas : fin 0.65 m.² (6.9 sq. ft.), rudder 1.00 m.² (10.8 sq. ft.), tailplane 1.37 m.² (14.7 sq. ft.), elevators 1.25 m.² (13.4 sq. ft.), span of tail 3.0 m. (9 ft. 10 in.).

LANDING GEAR.—Fixed tail-wheel type. Cantilever main legs with hydraulic shock-absorbers. Mechanical single-disc brakes. Track 1.83 m. (6 ft.).

POWER PLANT.—One 145 h.p. Continental C145 six-cylinder horizontally-opposed air-cooled engine. Two-blade fixed-pitch wood airscrew. Fuel tank in fuselage. Fuel capacity 125 litres (27.5 Imp gallons). Oil capacity 7.6 litres (1.6 Imp. gallons).

ACCOMMODATION.—Enclosed cockpit seating two side-by-side with dual controls. Adjustable seats. Baggage compartment behind cabin.

DIMENSIONS.—
Span 10.6 m. (34 ft. 9 in.).
Length 7.9 m. (25 ft. 11 in.).
Height 2.05 m. (6 ft. 8½ in.).

WEIGHTS.—
Weight empty 515 kg. (1,133 lb.).
Disposable load (semi-aerobatic) 285 kg. (627 lb.).
Disposable load (touring) 315 kg. (693 lb.).
Weight loaded (semi-aerobatic) 800 kg. (1,826 lb.).

PERFORMANCE.—
Max. speed at S/L. 220 km.h. (136 m.p.h.).
Cruising speed at S/L 200 km.h. (124 m.p.h.).
Cruising speed at 2,000 m. (6,560 ft.) 205 km.h. (127 m.p.h.).
Stalling speed, flaps up (indicated) 90 km.h. (56 m.p.h.).
Stalling speed, flaps down 85 km.h. (53 m.p.h.).
Rate of climb at S/L. 246 m/min. (810 ft./min.).
Time to 1,000 m. (3,280 ft.) 4.8 min.
Time to 2,000 m. (6,560 ft.) 10.5 min.
Time to 3,000 m. (9,840 ft.) 18 min.
Service ceiling 4,800 m. (15,740 ft.).
Take-off run 250 m. (273 yds.).
Take-off distance to clear 15 m. (50 ft.) 350 m. (383 yds.).
Landing run (with brakes) 120 m. (131 yds.).

FINLAND

EKLUND

TOROLF EKLUND.

HALLI, FINLAND.

Mr. T. Eklund, a Finnish aeronautical engineer, has designed in his spare time a small single-seat amphibian flying-boat which has been built in one of the State Metal Factories.

Known as the TE-1, this aircraft made its first flight on February 24, 1949, powered by a 25-28 h.p. Poinsard flat-twin engine. Because of crankcase failure and the impossibility of getting spares for this obsolete French engine, the TE-1 was later fitted with a 40 h.p. Continental A40 engine and is now flying as the TE-1B with 65 h.p. Walter Mikron III engine.

A full description of the TE-1B appeared in the 1956-57 edition of "All the World's Aircraft."

HEINONEN

JUHANI HEINONEN.

ADDRESS: HELSINKI AIRPORT, HELSINKI.

Mr. J. Heinonen, a Finnish aeronautical engineer, former designer at the Valmet Oy Aircraft Factory in Tampere and now employed by Finnair (Aero Oy), has in his spare time designed and built, at the Jämi Soaring School, a small single-seat monoplane, the HK-1. The prototype made its first flight in August, 1954.

On July 10, 1957, Mr. Heinonen flying his HK-1 set up an international distance record for light aircraft weighing less than 500 kg. (1,100 lb.) by flying from Madrid to Turku, Finland (2,844 km.= 1,766 miles) non-stop in 17 hours 1 minute.



The Heinonen HK-I (65 h.p. Walter Mikron III engine).

THE HEINONEN HK-1.

TYPE.—Single-seat Sports and Aerobatic monoplane.

WINGS.—Low-wing cantilever monoplane. Wing section NACA 643A418 (root), NACA 631A412 (tip). Aspect ratio 6.8. Root chord 1.34 m. (4 ft. 5 in.), tip chord 0.615 m. (2 ft.). Dihedral 5°. Incidence (at root) 3°. One piece all-wood wing attached to the fuselage by four bolts. One main spar of I-section. Slotted ailerons are fabric covered. Split flaps are of Alclad sheet and have a duralumin torsion tube. Total flap area 0.94 m.² (10.1 sq. ft.). Total area of ailerons 0.69 m.² (7.4 sq. ft.). Gross wing area 7 m.² (75 sq. ft.).

FUSELAGE.—Plywood covered all-wood structure with four longerons. The frames have straight sides. The fin is integral with the fuselage.

TAIL UNIT.—Cantilever all-wood structure. The rudder and elevator are fabric covered. Adjustable trim-tab in the elevator.

LANDING GEAR.—Fixed tail-wheel type. Cantilever spring steel main legs are attached to the wing. Steerable tail-wheel. Track 2 m. (6 ft. 6 in.).

POWER PLANT.—One 65 h.p. Walter Mikron III four-cylinder in-line inverted air-cooled, or any equivalent engine. Two-blade wooden airscrew 1.53 m. (5 ft.) in diameter. Fuel capacity 58 litres (13 Imp. gallons).

ACCOMMODATION.—Rearward sliding canopy is made of Perspex. Luggage compartment 0.14 m.³ (5 cub. ft.) is behind the seat. The crash pylon is made of steel tube.

DIMENSIONS.—
Span 6.9 m. (22 ft. 6 in.).
Length 5.35 m. (17 ft. 6 in.).
Height (from airscrew tip) 2.1 m. (6 ft. 10 in.).

WEIGHTS AND LOADINGS.—
Weight empty 250 kg. (550 lb.).
Weight loaded (aerobatic category) 360 kg. (795 lb.).
Weight loaded (normal category) 400 kg. (880 lb.).
Wing loading (aerobatic category) 51.4 kg./m.² (10.5 lb./sq. ft.).
Power loading (aerobatic category) 5.53 kg./h.p. (12.2 lb./h.p.).

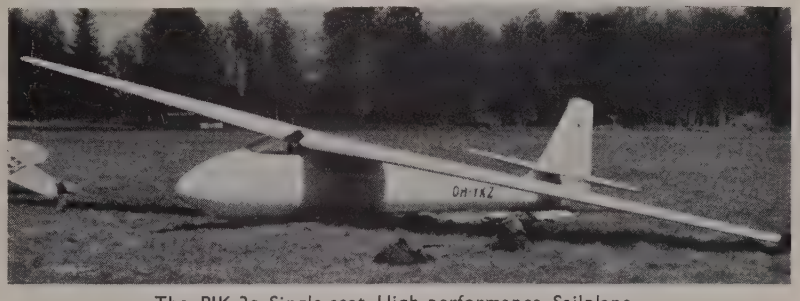
PERFORMANCE.—
Max. speed at S/L 223 km.h. (139 m.p.h.).
Cruising speed at S/L 195 km.h. (121 m.p.h.).
Landing speed 75 km.h. (47 m.p.h.).
Rate of climb at S/L. 270 m./min. (880 ft./min.).
Max. range 760 km. (470 miles).
Take-off distance to 15.25 m. (50 ft.) in still air 240 m. (789 ft.).
Landing distance from 15.25 m. (50 ft.) in still air 350 m. (1,155 ft.).

PIK

POLYTEKNIKKOJEN ILMAILUKERHO (THE FLYING CLUB OF THE FINNISH INSTITUTE OF TECHNOLOGY).

ADDRESS: LÖNNROTINKATU 29, HELSINKI.

This club was established in 1931 and has since been engaged mainly in gliding activities. Of the series of gliders designed and constructed, the primary glider PIK-7, the intermediate types PIK-5a, b and c and the advanced sailplanes PIK-3a, b and c are of particular interest due to the fact that they have been accepted as standard types for Finnish Gliding Clubs. The first Finnish two-seat sailplane, the PIK-12, was completed and flown in May, 1956. The latest in the PIK-3 series is the 3c which flew for the first time on May 20, 1958.



The PIK-3c Single-seat High-performance Sailplane.

THE PIK-3C.

The PIK 3c, a high-performance single-seat sailplane, is a progressive development of the earlier 3a and 3b and conforms to the new FAI standard 15-metre class. The prototype flew for the first time on May 20, 1958.

TYPE.—Single-seat high-performance Sailplane.

WINGS.—High-wing cantilever monoplane. Göttingen laminar-flow wing section. Aspect ratio 17. Chord 1.32 m. (4 ft. 4 in.) at root, 0.45 m. (1 ft. 5½ in.) at tip. All-wood plywood-covered structure. Air brakes on undersurfaces of wings. Gross wing area 13.1 m.² (140.9 sq. ft.).

FUSELAGE.—All-wood plywood-covered structure.

TAIL UNIT.—Cantilever monoplane type. Span of tail 3.0 m. (9 ft. 10 in.).

LANDING GEAR.—Wood skid, single wheel and tail-skid. Rubber springing. Wheel brake.

ACCOMMODATION.—Enclosed cockpit.

DIMENSIONS.—
Span 15 m. (49 ft. 2 in.).
Length 6.6 m. (21 ft. 8 in.).
Height 1.0 m. (3 ft. 3 in.).

WEIGHTS.—
Weight empty 165 kg. (363 lb.).
Max. flight weight 275 kg. (605 lb.).

PERFORMANCE.—
Placard air speed (smooth conditions) 250 km.h. (155 m.p.h.).
Aero-towing speed 140 km.h. (87 m.p.h.).
Winch-launching speed 110 km.h. (68 m.p.h.).
Stalling speed 55 km.h. (34 m.p.h.).
Min. sinking speed 0.61 m./sec. (1.8 ft./sec.) at 65 km.h. (40 m.p.h.).

VALMET

VALMET OY, LENTOKONETEHDAS (Aircraft Factory).

OFFICE AND WORKS: TAMPERE.

The Aircraft Factory forms part of the concern known as the State Metal Works, which was established by bringing the former State Aircraft Factory and several other State-owned metal-working factories under a central management. The present Aircraft Factory, a direct continuation of the former State Aircraft Factory, belongs to the Tampere Factory Group which consists of the Aircraft Factory at Tampere, as the central unit, and the Kuorevesi Factory which undertakes aircraft repairs. The Linnavuori Factory at Siuro, near Tampere, is producing

chiefly engines and repairing and overhauling D.H. Goblin turbojets.

The recent production activities of the Aircraft Factory have been concentrated on the Vihuri, a two-seat advanced training monoplane. The prototype VH-I flew for the first time on February 6, 1951. The first series of the Vihuri was produced for the Finnish Air Force in a slightly modified form as the Vihuri VH-II. The first production VH-II was flown on August 3, 1953.

A second slightly-modified series of the Vihuri was produced for the Finnish Air Force as the Vihuri-III. This series was completed and delivered during the latter half of 1956.

The Factory has also designed and built for the Finnish Air Force the prototype of a primary trainer known as the Tuuli-III. The prototype flew for the first time on May 31, 1957, and after completing its flight tests was delivered to the Finnish Air Force in March, 1958. The series version will be known as the Tuuli-IV.

A licence for the manufacture of the Folland Gnat light fighter was acquired in 1957, but no series production has yet begun.



The Valmet Tuuli-III (225 h.p. Continental O-470-A engine).

THE VALMET TUULI-III.

TYPE.—Four-seat Liaison/two-seat Aerobatic Trainer.

WINGS.—Low-wing cantilever monoplane. Wing sections NACA 643-418 (root) 632-415 (at 75% of span). Geometric twist −4° 30′. Wing chord 2.15 m. (7 ft.) at root, 0.945 m. (3 ft. 1 in.) at tip. Dihedral 6°. Incidence 3°. Aluminium-alloy single-spar structure. All-metal slotted flaps and slotted ailerons with spring-tabs. Total flap area 2.23 m.² (24 sq. ft.). Total aileron area 1.72 m.² (18.51 sq. ft.). Gross wing area 17.02 m.² (183.2 sq. ft.).

FUSELAGE.—Monocoque structure with stringers and Alclad frames and skin, built in three sections.

TAIL UNIT.—Cantilever monoplane type. Aluminium-alloy structure. The elevator halves and rudder each fitted with combined balance and trim tab. Areas: fin 1.07 m.² (11.52 sq. ft.), rudder 0.94 m.² (10.12 sq. ft.), tailplane 2.40 m.² (25.83 sq. ft.), elevators 1.83 m.² (19.70 sq. ft.). Tailplane span 4.2 m. (13 ft. 9¼ in.).

LANDING GEAR.—Tail wheel type, main wheels retractable. Dowty liquid-spring shock-absorbers. Dunlop wheels and hydraulic disc brakes, with parking brake. Main wheels and tail-wheel can be replaced by non-retractable skis. Track 3.38 m. (11 ft. 1 in.).

POWER PLANT.—One 225 h.p. Continental O-470-A six-cylinder horizontally-opposed air-cooled engine driving a Hartzell two-blade constant-speed metal airscrew, 2.13 m. (7 ft.) diameter. Ejector cooling system. Two flexible fuel tanks in wings, one on each side of fuselage, with collector tank containing electric booster pump in fuselage. Total fuel capacity 260 litres (57.2 Imp. gallons).

ACCOMMODATION.—Two 25g. front seats side-by-side, adjustable in flight, with dual controls and a wide 25g. rear seat for two persons. A patient on standard stretcher and a nurse can be accommodated. Large baggage hold, accessible from inside and outside, behind rear seat. By removing rear seat a spacious compartment for cargo is provided. Both sides of canopy are hinged to the central reinforced turnover beam and are jettisonable. Cabin is heated and ventilated. Complete blind-flying and navigation instrumentation and equipment, including VHF and ADF.

DIMENSIONS.—
Span 11.0 m. (36 ft. 1 in.).
Length 8.0 m. (26 ft. 2½ in.).
Height 2.8 m. (9 ft. 2 in.).

WEIGHTS.—
Weight empty 1,080 kg. (2,381 lb.).
Disposable load 560 kg. (1,235 lb.).
Weight loaded 1,640 kg. (3,616 lb.).

PERFORMANCE (at 1,440 kg. = 3,175 lb. loaded weight).—
Max. speed at S/L 255 km.h. (159 m.p.h.).
Cruising speed at S/L 215 km.h. (134 m.p.h.).
Rate of climb at S/L 270 m./min. (890 ft./min.).
Endurance over 5 hours.



The Valmet Tuuli-III (225 h.p. Continental O-470-A engine).

THE VALMET TUULI-IV.

The Tuuli-IV will be the production version of the previously-described aircraft. It will be powered by either the 240 h.p. Lycoming O-470-M or the 260 h.p. GO-480-B1C engine. The figures below are for the 260 h.p. version.

WEIGHTS (Normal category—estimated).—
Weight empty 1,125 kg. (2,480 lb.).
Disposable load 565 kg. (1,246 lb.).
Weight loaded 1,690 kg. (3,726 lb.).

PERFORMANCE (at 1,500 kg. = 3,307 lb. loaded weight—estimated).—
Max. speed at S/L 270 km.h. (168 m.p.h.).
Cruising speed at 2,000 m. (6,560 ft.) 215 km.h. (156 m.p.h.).
Rate of climb at S/L 320 m./min. (1,050 ft./min.).
Service ceiling 5,200 m. (16,700 ft.).
Range (including allowance for starting, warm-up, take-off and climb, plus ½-hour reserve) at 1,000 m. (3,280 ft.) and 205 km.h. (127 m.p.h.) 1,125 km. (700 miles).

THE VALMET VH-II VIHURI (SQUALL).

TYPE.—Two-seat Advanced Trainer.

WINGS.—Low-wing cantilever monoplane. Wing section NACA 0019-64 (root), NACA 23009 (tip). Aspect ratio 5.7. Chord 2.49 m. (7 ft. 7 in.) at root, 1.2 m. (3 ft. 8 in.) at tip. Dihedral (outer wings) 5°. Incidence (at root chord) 3°. Sweepback 4° at 25% chord. Light alloy stressed-skin structure. Modified Frise-type ailerons have light-alloy frames and fabric covering. Light alloy split flaps inboard of ailerons. Total area of ailerons 1.46 m.² (15.7 sq. ft.). Total area of flaps 1.85 m.² (19.9 sq. ft.). Gross wing area 18.86 m.² (202.9 sq. ft.).

FUSELAGE.—Forward section of fuselage is a welded chrome-molybdenum steel tube structure with Alclad covering. Rear section is a light metal stressed-skin monocoque.

TAIL UNIT.—Light alloy stressed-skin structure. Areas: fin 2.61 m.² (28.0 sq. ft.), rudder 0.82 m.² (8.8 sq. ft.), tailplane 2.79 m.² (20.0 sq. ft.), elevators (total) 1.21 m.² (13.0 sq. ft.). Tailplane span 3.74 m. (12 ft. 3 in.).

LANDING GEAR.—Retractable tail-wheel type. Hydraulic retraction. Valmet oil/spring shock-absorbers. Valmet wheels, Dunlop tyres and Valmet hydraulic brakes. Track 2.64 m. (8 ft. 8 in.).

POWER PLANT.—One Bristol Mercury VIII nine-cylinder radial air-cooled engine rated at 820 h.p. at 2,650 r.p.m. at 4,100 m. (13,450 ft.) and with a maximum take-off power of 720 h.p. at 2,650 r.p.m. at sea level. Modified three-blade D.H. constant-speed metal airscrew. Two main rubber bag tanks (195 litres = 43 Imp. gallons each) and two auxiliary tanks (130 litres = 28.6 Imp. gallons each) in centre-section. Total fuel capacity 630 litres (138 Imp. gallons). Oil capacity 30 litres (6.5 Imp. gallons).

ACCOMMODATION.—Enclosed cockpit seating two in tandem (pupil in front) with dual controls. Sliding jettisonable Perspex canopy. Seats and rudder-pedals are adjustable. Provision for amber screening for blind-flying training. 24-volt electrical system. VHF transmitter/receiver, blind-approach equipment and radio compass.

DIMENSIONS.—
Span 10.4 m. (33 ft. 1 in.).
Length 8.8 m. (28 ft. 9 in.).
Height 3.86 m. (12 ft. 8 in.).

WEIGHTS AND LOADINGS.—
Max. loaded weight (normal fuel) 2,678 kg. (5,892 lb.).
Max. loaded weight (with auxiliary fuel) 2,884 kg. (6,345 lb.).
Wing loading (normal fuel) 142 kg./m.² (29.11 lb./sq. ft.).
Power loading (normal fuel) 3.26 kg./h.p. 7.17 lb./h.p.).



The Valmet VH-II Vihuri Advanced Trainer (820 h.p. Bristol Mercury engine).

PERFORMANCE (at 2,678 kg. = 5,892 lb. A.U.W.).—
Max. speed 432 km.h. (268 m.p.h.) at 3,700 m. 12,140 t.).
Econ. cruising speed 327 km.h. (203 m.p.h.)
Landing speed 135 km.h. (83.8 m.p.h.).
Initial rate of climb 690 m./min. (2,263 ft./min.).
Rate of climb at 3,700 m. (12,140 ft.) 660 m./min. (2,165 ft./min.).
Service ceiling 8,900 m. (29,190 ft.).
Take-off to 15.25 m. (50 ft.) 700 m. (765 yds.).
Landing distance from 15.25 m. (50 ft.) 750 m. (820 yds.).

THE VALMET VH-III VIHURI (SQUALL).

TYPE.—Two-seat Advanced Trainer.
WINGS.—Same as for VH-II, except spring-tab ailerons instead of modified Frise-type.
FUSELAGE.—Same as for VH-II.
TAIL UNIT.—Same as for VH-II.
LANDING GEAR.—Same as for VH-II, except wheels, tyres and disc brakes all made by Dunlop.
POWER PLANT.—Same as for VH-II.
ACCOMMODATION.—Same as for VH-II, but without blind-approach equipment.
ARMAMENT.—One 7.7 mm. machine-gun in each wing. Gyro gun-sight. Camera recorder. Attachment points for 2 × 25 kg. bombs under each wing.
DIMENSIONS.—
Same as for VH-II.



The Valmet VH-III Vihuri Advanced Trainer (820 h.p. Bristol Mercury engine).

WEIGHTS AND LOADINGS.—
Max. weight loaded (normal fuel, full armament) 2,880 kg. (6,340 lb.).
PERFORMANCE.—
Same as for VH-II.

FRANCE

AUBERT

AVIONS PAUL AUBERT.

HEAD OFFICE: 6, SQUARE CLAUDE DEBUSSY, PARIS (17E).

WORKS: BUC AERODROME, NEAR VERSAILLES (SEINE-ET-OISE).

M. Paul Aubert, a pilot of the 1914-18 war, formed Aubert-Aviation in 1932 and in 1936 began the design of aircraft. The first aircraft he built was the PA-20 Cigale, a side-by-side trainer which, after successful trials, was exhibited at the 1938 Paris Salon.

In 1938 Aubert-Aviation became the Société Anonyme des Avions P. Aubert. Considerable sub-contract work was undertaken for the nationalised aircraft industry and a direct contract for production of a number of Morane-Saulnier M.S. 230 trainers was placed with the company by the French Government. All this work ceased in June, 1940.

After the war Aubert revised the PA-20, the prototype of which had been destroyed during the occupation. In its revised form as the PA-201, and powered by a 140 h.p. Renault engine, it won many competitions.

The current development of this original design is the PA-204 Super Cigale, the prototype of which flew in April, 1949 and received its Certificate of Airworthiness in November, 1951.



The Aubert Super Cigale (150 h.p. Lycoming engine). (*J. W. R. Taylor*).

THE AUBERT CIGOGNE.

The Cigogne, which is now under development, will be a twin-engined six-seat executive type aircraft of mixed wood and metal construction. It will be a high-wing monoplane with a retractable tricycle landing-gear and will be powered by two Lycoming engines (180 to 240 h.p.).

No further details were available at the time of closing for press.

THE AUBERT PA-204 SUPER CIGALE.

The Super Cigale was designed and built originally with a 180 h.p. SNECMA engine, but is now available with Lycoming engines of from 135 to 180 h.p. The prototype 135 h.p. version flew for the first time on July 27, 1955, and featured a wider cabin with better forward view than the earlier prototype.

A batch of thirty of the revised model was put in hand, including eight for the Aéro-Club Air France, and production was continuing through 1958.

TYPE.—Four-seat Touring monoplane.

WINGS.—High-wing cantilever monoplane. Aspect ratio 7.8. One-piece all-wood wing with elliptical outer sections. Entire trailing-edge hinged, outer sections as ailerons, inner sections as flaps. Gross wing area 12.92 m.² (139 sq. ft.).

FUSELAGE.—All-wood monocoque structure.

TAIL UNIT.—Cantilever monoplane type. All-wood structure. Adjustable tailplane. Areas: fin 0.59 m.² (6.35 sq. ft.), rudder 0.77 m.² (8.28 sq. ft.), tailplane 1.55 m.² (16.62 sq. ft.), elevators 1.65 m.² (17.75 sq. ft.). Tailplane span 3.80 m. (12 ft. 5½ in.).

LANDING GEAR.—Fixed tail-wheel type. Main cantilever legs are sprung within the fuselage by rubber blocks. Orientable tail-wheel. Track 2.80 m. (9 ft. 2 in.).

POWER PLANT.—One 150 or 180 h.p. Lycoming four-cylinder horizontally-opposed air-cooled engine driving a Hartzell two-blade constant-speed airscrew. Two fuel tanks (75 litres = 16.5 Imp. gal. each) in wing, one on each side of fuselage.

ACCOMMODATION.—Enclosed cabin seating four in two pairs. Alternatively, can accommodate pilot and one stretcher in ambulance rôle, or 300 kg. (660 lb.) of freight. Two upward-hinged doors, one on each side. Cabin is sound-proofed and air conditioned. The seats are upholstered in Dunlopillo.

DIMENSIONS.—
Span 10.0 m. (32 ft. 9 in.).
Length 7.50 m. (24 ft. 7 in.).
Height 2.40 m. (7 ft. 10 in.).

WEIGHTS.—
Weight empty 640 kg. (1,408 lb.).
Weight loaded 1,250 kg. (2,755 lb.).

PERFORMANCE (150 h.p. Lycoming).—
Max. speed 255 km.h. (158 m.p.h.).
Cruising speed (70% power) 230 km.h. (143 m.p.h.).
Landing speed 90 km.h. (56 m.p.h.).
Rate of climb at S/L. 270 m./min. (885 ft./min.).
Service ceiling 4,500 m. (14,750 ft.).
Take-off distance 230 m. (755 ft.).
Landing distance 120 m. (395 ft.).
Range 1,880 km. (1,168 miles).
Fuel consumption 32 litres/hr. (7.04 Imp. gal./hr.).

PERFORMANCE (180 h.p. Lycoming).—
Max. speed 270 km.h. (168 m.p.h.).
Cruising speed 245 km.h. (153 m.p.h.).
Landing speed 90 km.h. (56 m.p.h.).
Rate of climb at S/L. 300 m./min. (985 ft./min.).
Service ceiling 5,000 m. (16,400 ft.).
Take-off distance 200 m. (655 ft.).
Landing distance 120 m. (395 ft.).
Range 1,880 km. (1,168 miles).
Fuel consumption 36 litres/hr. (7.9 Imp. gal./hr.).

BOISAVIA

SOCIÉTÉ BOISAVIA.

HEAD OFFICE: 11, RUE PIERRE-BROSSOLETTE, IVRY-SUR-SEINE.

The principal product of Boisavia, which was founded in 1948 and is under the direction of M. Lucien Tielès, is the B.60 Mercurey, a four-seat cabin monoplane which was developed from the earlier B.50 Muscadet three-seater. Series production of the Mercurey is undertaken in the factory of Brissonneau et Lotz, at Creil (Oise).

The latest production is the B.260 Anjou, a twin-engined cabin monoplane, the prototype of which made its first flight on June 2, 1956.

THE BOISAVIA B.60 MERCUREY.

Apart from the basic B.60 Mercurey, the prototype of which first flew in March, 1948 and has been followed by 28 production models, the following variants have been built:—

B.601. Agricultural version of the B.60. Fitted with a 190 h.p. Lycoming engine.

B.602. Similar to B.60 but fitted with a 165 h.p. Continental engine.

B.603. Developed specifically as a glider-tug, with increased wing span. Powered by a 240 h.p. Argus As 10 engine. Prototype flew on April 11, 1951 and first production B.603 in 1952. In official tests, towing a Nord 2000 sailplane, the B.603 has taken off in 120 m. (393 ft.) climbed to 1,000 m. (3,280 ft.) in 3½ minutes and reached 5,600 m. (18,370 ft.) in 56 minutes. Five ordered by S.F. A.S.A.

B.604. Glider-tug. Development of the B.603 with longer fuselage, higher fin and a new landing gear. Powered by a 230 h.p. Salmson 9 Abc radial engine. Prototype flew on January 6, 1954.

B.605. Four-seat tourer and trainer. Similar to B.60 except fitted with 170 h.p. SNECMA Regnier 4L 02 engine. First flew on April 29, 1954.



The Boisavia B.60 Mercurey (150 h.p. Lycoming O-320 engine).

TYPE.—Four-seat Cabin monoplane.

WINGS.—High-wing rigidly-braced monoplane. NACA 23.012 wing section. Aspect ratio 7.1 (7.5 on B.603). Chord 1.60 m. (5 ft. 3 in.). Dihedral 1° 30′. Incidence 3° 30′. Two-spar wooden structure with stressed plywood skin. Vee bracing-struts. Slotted aerodynamically-balanced ailerons. Built-in leading-edge slots ahead of ailerons. Trailing-edge flaps between ailerons 152 fuselage. Total area of ailerons 1.52 m.² (16.36 sq. ft.). Total area of flaps 2.30 m.² (24.76 sq. ft.). Wing area 18 m.² (193.6 sq. ft.) (19.20 m.² = 206.66 sq. ft. on B.603).

FUSELAGE.—Welded steel-tube structure covered with fabric.

TAIL UNIT.—Cantilever monoplane type. Tailplane structure similar to that of wings. Balanced elevators and rudder. Trim-tabs, adjustable on ground, in port elevator and

rudder. Areas: fin 1.5 m.² (16.15 sq. ft.), rudder 0.65 m.² (7.0 sq. ft.), tailplane 1.45 m.² (15.60 sq. ft.), elevators 2.90 m.² (31.20 sq. ft.).

LANDING GEAR.—Fixed type with divided axle. Sandows shock-absorbers. Boisavia wheels size 550×175. Hydraulic brakes. Steerable tail-wheel. Wheel track 2.50 m. (8 ft. 2½ in.).

POWER PLANT (B.60).—One 150 h.p. Lycoming O-320 or 170 h.p. Lycoming O-340 four-cylinder horizontally-opposed air-cooled engine, driving a Ratier metal airscrew. Fuel in two wing tanks with total capacity of 220 litres (48.4 Imp. gallons). Oil capacity 7 litres (1.5 Imp. gallons).

POWER PLANT (B.603).—One 240 h.p. Argus As.10 engine driving Merville wooden airscrew. Fuel as in B.60. Oil capacity 15 litres (3.3 Imp. gallons).

ACCOMMODATION.—Cabin seats four in two pairs with dual controls to the front pair. One-piece windscreen, transparent roof and fairing over rear seats. Large door on each side opens upward for access to both front and rear seats. Baggage compartment at back of cabin accessible from inside. Soundproofing, heating and ventilation. Passenger seats quickly removable so that cabin may be used for light freight.

DIMENSIONS (B.60).—
Span 11.38 m. (37 ft. 4 in.).
Length 7.20 m. (23 ft. 7 in.).
Height 2.20 m. (7 ft. 3 in.).

DIMENSIONS (B.603).—
Span 12.0 m. (39 ft. 4½ in.).
Length 7.70 m. (25 ft. 3 in.).
Height 2.20 m. (7 ft. 3 in.).

WEIGHTS (B.60).—
Weight empty 710 kg. (1,565 lb.).
Weight loaded 1,277 kg. (2,815 lb.).

WEIGHTS (B.603).—
Weight empty 830 kg. (1,830 lb.).
Weight loaded 1,277 kg. (2,815 lb.).

PERFORMANCE (B.60).—
Max. speed 235 km.h. (146 m.p.h.).
Cruising speed 200 km.h. (124 m.p.h.).
Stalling speed 70 km.h. (43.5 m.p.h.).
Ceiling 5,500 m. (18,040 ft.).
Take-off run 210 m. (690 ft.).
Landing run 150 m. (490 ft.).
Range 1,200 km. (745 miles).

PERFORMANCE (B.603).—
Max. speed 245 km.h. (152 m.p.h.).
Cruising speed 200 km.h. (124 m.p.h.).
Stalling speed 70 km.h. (43.5 m.p.h.).
Ceiling 5,500 m. (18,040 ft.).
Take-off run 150 m. (490 ft.).
Landing run 150 m. (490 ft.).
Range 800 km. (500 miles).



The Boisavia B.603 Mercurey Glider-tug (240 h.p. Argus engine).

THE BOISAVIA B.260 ANJOU.

The first prototype of the four-seat B.260 Anjou made its first flight on June 2, 1956, powered by two 170 h.p. SNECMA-Régnier 4LO2 engines. It will be followed by a second prototype with 170 h.p. Lycoming O-340 engines and a pre-series of three production Anjous. A seven-seat version with 220 h.p. Potez 4D.31 engines is also under development.

The wing-tip "balonets" have an aerodynamic function by increasing the effective wing-span, and are used also as auxiliary fuel tanks.

TYPE.—Twin-engined Cabin monoplane.

WINGS.—Low-wing cantilever monoplane. Aspect ratio 7.6. Chord 1.70 m. (5 ft. 7 in.). Dihedral 5°. Incidence 3° 30′. Two-spar metal structure. Metal covered, except for some fabric covering between the spars outboard of the engines. All-metal ailerons. Electrically-operated all-metal flaps, with manual emergency control. Total area of ailerons 2.0 m.² (21.53 sq. ft.). Total area of flaps 2.4 m.² (25.83 sq. ft.). Gross wing area 21.5 m.² (231.42 sq. ft.).

FUSELAGE.—Steel tube structure, with metal covering.

TAIL UNIT.—Cantilever monoplane type. All-metal construction. Areas: fin 2.0 m.² (21.53 sq. ft.), rudder 0.7 m.² (7.53 sq. ft.), tailplane 2.16 m.² (23.25 sq. ft.), elevators 3.52 m.² (37.89 sq. ft.).

LANDING GEAR.—Retractable tricycle type. Boisavia oleo-pneumatic shock-absorbers. Electric retraction, with manual emergency control. Boisavia wheels size 550×175. Hydraulic brakes. Wheel track 3.50 m. (11 ft. 6 in.).

POWER PLANT.—Two 170 h.p. SNECMA-Régnier 4LO2 four-cylinder in-line inverted air-cooled engines, driving two-blade Hartzell variable-pitch metal airscrews, or two 170 h.p. Lycoming O-340 four-cylinder horizontally-opposed air-cooled engines. Fuel in two wing tanks with total capacity of 450 litres (99 Imp. gallons) and two wing-tip tanks with total capacity of 200 litres (44 Imp. gallons). Oil capacity 14 litres (3 Imp. gallons).

ACCOMMODATION.—Enclosed cabin seating four persons. Starboard front seat and the rear bench-type seat can be removed for cargo carrying. Floor is stressed to bear heavy concentrated loads.

DIMENSIONS.—
Span 13 m. (42 ft. 8 in.).
Length 7.20 m. (23 ft. 7 in.).
Height 3 m. (9 ft. 10 in.).

WEIGHTS.—
Weight empty 1,300 kg. (2,866 lb.).
Weight loaded 2,000 kg. (4,410 lb.).

PERFORMANCE.—
Max. speed 300 km.h. (186 m.p.h.).
Economical cruising speed 240 km.h. (149 m.p.h.).
Min. speed 90 km.h. (56 m.p.h.).
Ceiling 6,800 m. (22,300 ft.).
Take-off run 160 m. (525 ft.).
Landing run 150 m. (490 ft.).
Range 1,500 km. (930 miles).
Rate of climb on one engine at 1,500 m. (5,000 ft.) 50 m./min. (165 ft./min.).

BREGUET

SOCIÉTÉ ANONYME DES ATELIERS D'AVIATION LOUIS BREGUET.

HEAD OFFICE: 24, RUE GEORGES-BIZET, PARIS (XVIe).

WORKS: VILLACOUBLAY (SEINE-ET-OISE), TOULOUSE (HAUTE-GARONNE), BAYONNE (BASSES-PYRÉNÉES) AND AIRE-SUR-ADOUR.

President and Director-General: Sylvain Floirat.

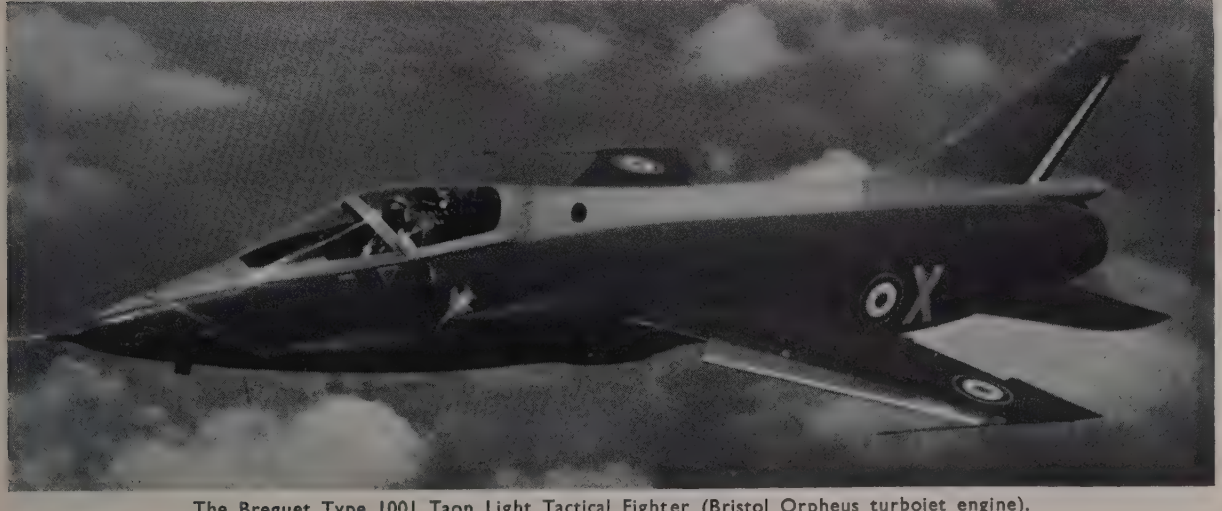
General Manager: Henri Ziegler.

The Breguet company was founded in 1911 by M. Louis Breguet, one of the great pioneers of French aviation, who died on May 4, 1955, at the age of 75.

The two main factories of the Breguet company were incorporated into the nationalised industry in 1936, but three years later it regained some measure of independence through the purchase of the former Latécoère factories at Toulouse, Bayonne and Biscarosse.

Breguet is developing the single-engined Type 1001 tactical support aircraft to N.A.T.O. specifications and the Type 1050 anti-submarine "hunter-killer" for the French Navy. An initial production order for a small number of Type 1050 aircraft has been followed by a much larger contract to equip the aircraft carriers now in service with the French Navy and the two new carriers under construction.

Breguet is also engaged in the development of aircraft employing the "blown-wing" principle of high lift to provide short take-off and landing runs. The



The Breguet Type 1001 Taon Light Tactical Fighter (Bristol Orpheus turbojet engine).



The Breguet Type 1050 Alizé Three-seat Anti-Submarine Monoplane (Rolls-Royce Dart turboprop engine).

principle involves the use of four large diameter airscrews, equally distributed spanwise, and large double flaps. The slipstream of the airscrews gives, even at zero forward speed, an important amount of lift. The first aircraft in this series is the Type 940, an experimental aircraft which has been built to prove the principle which has been under development for the last ten years. The Type 941 will be of similar configuration to the Type 940, but larger.

Breguet is building, in its Anglet plant, wings for the Nord 2501 twin-engined transport which is in production for the French Air Force. It is also producing in series, under a Rotol licence, the airscrews for this transport.

The Breguet Light Aircraft Department, under the technical direction of M. Jarlaud, the well-known specialist in high-performance sailplanes, was transferred to Aire-sur-Adour in 1957.

Early in 1957, Breguet acquired a financial interest in the Société Matra and it was announced that the two companies would work together on aircraft and missiles.

THE BREGUET TYPE 1001 TAON.

The Type 1001 is a single-seat lightweight ground attack fighter which has been designed to meet the NATO specification for a tactical fighter, with emphasis on maximum speed at sea level, high manoeuvrability in roll and good take-off and landing performances on unprepared strips In the evaluation of the designs by NATO, the Type 1001 was placed first. Three prototypes have been ordered, and the first of these flew on July 26, 1957.

The Taon (Gadfly or Horsefly) is a small swept-wing monoplane powered by a Bristol Orpheus turbojet engine. All wheels of the tricycle landing-gear retract into the fuselage.

The prototype, with an Orpheus 3 turbojet (2,200 kg.=4,850 lb. s.t.) has a wing area of 14.7 m.² (158 sq. ft.); but it will have a wing area of 20 m.² (215 sq. ft.) when fitted with an Orpheus 12 of much higher power.

DIMENSIONS.—
Length 11.30 m. (37 ft. 1 in.).
Height 3.70 m. (12 ft. 1½ in.).

WEIGHT.—
Weight loaded approx. 5,000 kg. (11,025 lb.).

THE BREGUET TYPE 1050 ALIZÉ.

The Type 1050 Alizé (Trade-wind) is a three-seat anti-submarine "hunter-killer" carrier-based aircraft derived from the Type 960 Vultur, which has been described in earlier editions of "All the World's Aircraft." The Nene engine which was mounted in the rear fuselage of the Type 960 has been removed and replaced by a retractable radar scanner. The airframe is lighter and the landing-gear simplified. The wings and tail-unit also differ from those of the Type 960.

The Alizé is powered by a specially adapted Rolls-Royce Dart RDa.7 turboprop engine. Its armament consists chiefly of bombs and rockets.

The first prototype of the Alizé flew on October 6, 1956, and five pre-production aircraft were being delivered in 1957. Orders for more than 100 production Alizés have been placed by the French Navy and these aircraft will be used on both light and fleet type aircraft carriers.

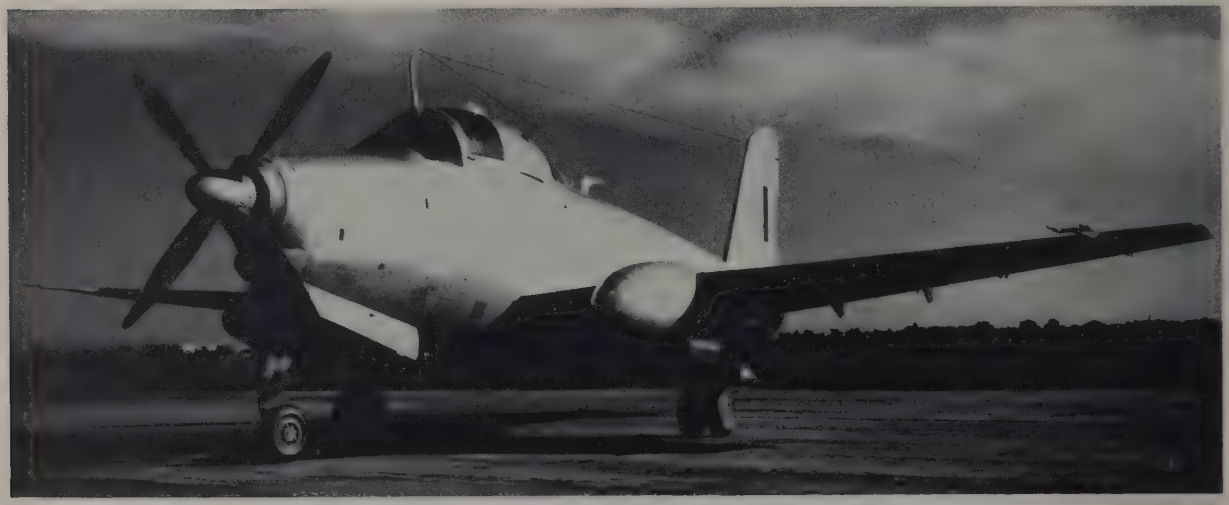
TYPE.—Three-seat Anti-submarine aircraft.

WINGS.—Cantilever low-wing monoplane, with hydraulically-folding outer panels. All-metal two-spar structure. Double-slotted flaps. Wing area 36 m.² (387.5 sq. ft.).

FUSELAGE. — All-metal semi-monocoque structure.

TAIL UNIT.—All-metal cantilever monoplane type.

LANDING GEAR.—Retractable tricycle type, the main wheels retracting forward into combined landing gear-armament nacelles on the wing leading edges. Hispano-Suiza double-chamber shock-absorbers. Twin wheels on main units. Steerable



The Breguet Type 1050 Alizé Three-seat Anti-Submarine Monoplane (Rolls-Royce Dart turboprop engine).



The Breguet Type 940 Integral (four Turbomeca Turmo II Shaft-turbine engines).

nose-wheel. Hydraulic brakes and landing gear retraction. Retractable arrester hook under rear fuselage.

POWER PLANT.—One 2,000 s.h.p. Rolls-Royce Dart R.Da.7 turboprop engine driving 3.53 m. (11 ft. 7 in.) diameter Rotol four-blade variable-pitch metal airscrew. Fuel tanks in wing centre-section and under cockpit.

ACCOMMODATION.—Enclosed cabin with side-by-side seats for pilot and forward radar operator at front and sideways-facing seat for rear operator behind on starboard side.

ARMAMENT.—Provision for bombs, depth charges, sono-buoys, rockets, etc., in fuselage bomb-bay, wing nacelles and under wings.

DIMENSIONS.—
Span 15.3 m. (50 ft. 2 in.).
Width folded 7 m. (22 ft. 11 in.).
Length 13.7 m. (45 ft.).
Height 5.18 m. (17 ft.).

WEIGHT.—
Weight loaded 8,000 kg. (17,640 lb.).

PERFORMANCE.—
Patrol speed range 220-330 km.h. (140-205 m.p.h.).
Endurance over 4 hr.
Max. range 2,500 km. (1,550 miles).

THE BREGUET TYPE 940 INTEGRAL.

The Type 940 is an experimental aircraft which incorporates what Breguet calls a "blown-wing" system. In this system the slipstream of four airscrews blows over the entire span of the wing, the trailing-edge of which is amply provided with slotted flaps and ailerons. The four engines are synchronised to maintain uniform r.p.m. and to ensure that all airscrews will continue to rotate in the event of an engine failure. All airscrews are synchronised for uniform pitch.

The prototype Type 940 made its first flight on May 21, 1958.

TYPE.—Four-engined Experimental Aircraft.

WINGS.—High-wing cantilever monoplane. Breguet L.14 wing section. Chord 2.65 m. (8 ft. 8 in.) constant. 17% thickness/chord ratio. All-metal structure. Entire trailing-edge hinged. Inboard flaps are in two sections chordwise and are triple-slotted, the third slot being a fixed one on the trailing section. Outboard flaps, also in two sections, are double-slotted, the trailing section serving as an aileron.

FUSELAGE.—Rectangular all-metal structure.

TAIL UNIT.—Cantilever monoplane type. Twin fins and rudders. All-metal structure.

LANDING GEAR.—Fixed tricycle type. Low-pressure tyres. Wheelbase 4.48 m. (14 ft. 8 in.). Track 4.0 m. (13 ft. 1 in.).

POWER PLANT.—Four 400 s.h.p. Turbomeca Turmo II free turbine engines, each driving through an aft-mounted engine gear-box, shaft and airscrew reduction gear a three-blade Ratier-Figeac variable-pitch airscrew 4.0 m. (13 ft. 1 in.) in diameter. All engine gear-boxes inter-connected by transverse shafts to ensure synchronisation and continued operation of all airscrews in event of an engine failure. Each side pair of airscrews contra-rotating (inboard clockwise, outboard anti-clockwise). Fuel carried in integral wing compartments.

ACCOMMODATION.—Flight compartment in nose. Pilot on port side. Additional seat for observer or engineer. Large hold beneath wing, with loading door and ramp aft.

DIMENSIONS.—
Span 17.50 m. (57 ft. 5 in.).
Length 12.00 m. (39 ft. 4 in.).

WEIGHT.—
Weight loaded 6,500 kg. (14,330 lb.).

PERFORMANCE (estimated).—
Max. cruising speed 380 km.h. (236 m.p.h.).
Landing speed 45 km.h. (28 m.p.h.).
Take-off run 60 m. (200 ft.).
Landing run 35 m. (115 ft.).

THE BREGUET TYPE 763 DEUX-PONTS AND TYPE 765 SAHARA.

The Breguet 763 and 765 are the production developments of the Type 761, the design of which was begun in 1944. The prototype 761 fitted with four 1,600 h.p. Snecma 14R engines flew for the first time on February 15, 1949, and was awarded a certificate of airworthiness at an all-up weight of 40,000 kg. (88,000 lb.).

A pre-series of three aircraft, designated Type 761 S, was then put into production, the first making its first flight in 1951. These three aircraft are identical to the prototype except that they are powered with four 2,000 h.p. Pratt & Whitney R-2800 B31 engines driving Ratier reversible-pitch airscrews. This type was awarded a C. of A. at a gross weight of 45,000 kg. (99,000 lb.).

Type 763. First production version of "Deux Ponts." Twelve ordered by Air France in 1951. Four 2,400 h.p. Pratt & Whitney R-2800 CA18 engines driving Hamilton Standard reversing airscrews. The fuselage is generally the same as in Type 761, but span is increased and the wings reinforced. Furthermore the accommodations were completely re-designed to meet Air France's requirements for a convertible passenger/cargo aircraft, the standard version carrying 59 tourist passengers on the upper deck and 48 second-class passengers on the lower deck. The flight compartment was re-arranged to meet Air France's request for the reduction of the flight crew from four to three.

The Type 763 is used by Air France under the type name "Provence." The prototype made its maiden flight on July 20, 1951, and was awarded a C. of A. for a take-off weight of 48,000 kg. (105,600 lb.), since increased to 51,600 kg. (113,800 lb.).



The Breguet Type 940 Integral (four Turbomeca Turmo II shaft-turbine engines).



The Breguet Type 763 Deux-Ponts Transport (four 2,400 h.p. Pratt & Whitney R-2800-CA18 engines).

Type 765 Sahara. Military transport version of "Deux Ponts." Fifteen ordered early in 1956. Fitted with four Pratt & Whitney R-2800-CB16 or CB-17 engines and military-style accommodations. First Type 765 flew on September 6, 1958.

The description which follows refers to the Type 765.

TYPE.—Four-engined Military Transport.

WINGS.—Cantilever mid-wing monoplane. Aspect ratio 9.95. Light alloy structure with stressed metal skin. Metal ailerons each in three sections on outer wings. Area (each) 9.2 m.² (99 sq. ft.). Breguet slotted flaps in four sections each side between ailerons and fuselage. Hydraulic actuation. Total flap area 27.51 m.² (296 sq. ft.). Gross wing area 185.4 m.² (1,996 sq. ft.).

FUSELAGE.—Two-deck monocoque in five main sections. Duralumin structure with stressed metal skin. Max. fuselage width 3.30 m. (10 ft. 9½ in.), max. depth 5.0 m. (16 ft. 5 in.).

TAIL UNIT.—All-metal cantilever structure consisting of tailplane mounted at top of fuselage with elevators on each side of central dorsal fin. Inset from tips of tailplane are the two-piece fins and rudders, latter with three trim and balance tabs each. Total horizontal area 41.90 m.² (449 sq. ft.). Total vertical area 21.98 m.² (236 sq. ft.). Dorsal fin area 7.12 m.² (76.8 sq. ft.).

LANDING GEAR.—Retractable tricycle type. Messier shock struts to all wheels. Twin main wheels, single nose-wheel, hydraulic retraction. Track 7.98 m. (26 ft. 2 in.).

POWER PLANT.—Four Pratt & Whitney R-2800 CB16 or CB17 eighteen-cylinder two-row radial air-cooled engines delivering 2,400 h.p. or 2,500 h.p. respectively at take-off with water injection. Hamilton Standard 43 E 60 three-blade constant-speed and reversing airscrews, 4.216 m. (13 ft. 8 in.) diameter. Total fuel capacity 15,300 litres (3,366 Imp. gallon); two 3,220 litre (708 Imp. gallon) tanks in outer wings; two 4,130 litre (908 Imp. gallon) tanks in centre-section and two 300 litres (66 Imp. gallon) reserve tanks one in each outer engine nacelle. Provision for two additional wing-tip tanks of 2,500 litres (550 Imp. gallon) each. Oil capacity 800 litres (173 Imp. gallons) in four tanks.

ACCOMMODATION.—Fuselage divided into two decks. Crew compartment in nose on upper deck with accommodation for five. Easily-convertible accommodation on two decks for up to 146 fully-equipped troops, or 85 litters and medical attendants, or freight, vehicles and equipment, including a 15-ton Army tank. Loading and unloading of freight hold through large rear panels beneath rear fuselage, operated by hydraulic jacks. Normal access for passengers through lateral doors in closed freight-loading panels aft and then by staircase to upper deck. A door on front starboard side for passengers or for loading small pieces of freight. Volume of lower deck 83.1 m.³ (2,934 cub. ft.). Lower deck floor 1.30 m. (4 ft.) from ground, permitting direct loading from trucks.

DIMENSIONS.—
Span 42.99 m. (140 ft. 5 in.).
Length 28.94 m. (94 ft. 11 in.).
Height 9.91 m. (32 ft. 7 in.).

WEIGHTS.—
Weight empty 31,000 kg. (68,343 lb.).
Crew (5) 400 kg. (880 lb.).
Fuel and oil 8,115-14,000 kg. (17,890-30,865 lb.).
Max. payload 13,000-17,000 kg. (28,660-37,480 lb.).
Max. take-off weight 54,000 kg. (119,050 lb.).
Max. landing weight 48,000 kg. (105,822 lb.).

PERFORMANCE.—
Max. cruising speed 380 km.h. (231 m.p.h.) at 3,050 m. (10,000 ft.).
Economic cruising speed 336 km.h. (210 m.p.h.) at 3,000 m. (9,840 ft.).
Rate of climb at S/L. 331 m./min. (1,080 ft./min.).
Rate of climb at 2,300 m. (5,000 ft.) 306 m./min. (1,000 ft./min.).
Rate of climb at S/L. (on 3 engines) 140 m./min. (460 ft./min.).
Climb to 3,000 m. (9,840 ft.) 19 min.
Take-off run to clear 15 m. (50 ft.) 1,550 m. (1,700 yds.).
Landing distance from 15 m. (50 ft.) 1,100 m. (1,200 yds.).
Max. range in still air (with 10% reserve of cruise fuel and allowance for 1 hour stacking and 300 km. diversion) at full load and using tip-tanks 4,000 km. (2,490 miles) at max. cruising speed, and 4,700 km. (2,930 miles) at most economical cruising speed.

THE BREGUET TYPE 901.

The Type 901 is a development of the Type 900, which was described in earlier editions of "All the World's Aircraft." It took first place in the 1954 World Championship contest for single-seat sailplanes and a production batch of 60 is now being built.

A new version known as the Type 901S, with modified flaps, larger tail unit and loaded weight of 415 kg. (915 lb.) won the single-seat class at the 1956 World Gliding Championships.

TYPE.—Single-seat High-performance Sailplane.

WINGS.—Shoulder-wing cantilever monoplane. NACA 63 Series laminar-flow wing section. Aspect ratio 20. Single spruce and plywood spar with leading-edge torsion box of plywood-klegecell sandwich. Slotted ailerons with 25° upward and 15° downward movement on outer halves of each half span. Slotted flaps inboard. Metal dive brakes on upper and lower surfaces. Gross wing area 15 m.² (161 sq. ft.).

FUSELAGE.—Wood structure with plywood skin. Fin integral with rear fuselage.

TAIL UNIT.—Cantilever monoplane type. Horizontal tail-surfaces can be folded. Total horizontal area 2.07 m.² (22.3 sq. ft.), total vertical area 1.02 m.² (11 sq. ft.).

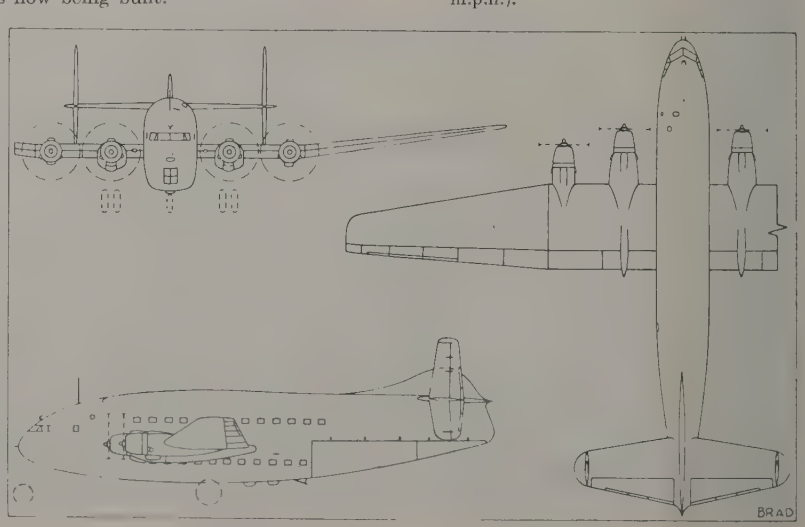
LANDING GEAR.—Single retracting wheel with hydraulic brake. Local reinforcement of fuselage around wheel allows wheels-up landing without serious damage to structure, while drag saving due to removal of skid is substantial.

ACCOMMODATION.—Single cockpit with flush canopy. Radio, blind-flying equipment and oxygen are provided.

DIMENSIONS.—
Span 17.32 m. (56 ft. 10 in.).
Length 7.16 m. (23 ft. 4 in.).

WEIGHTS.—
Without water ballast 315 kg. (694 lb.).
With water ballast 390 kg. (860 lb.).

PERFORMANCE.—
Max. L/D. ratio 36.
Min. rate of sink 0.65 m./sec. (2.13 ft./sec.). at 72 km.h. (45 m.p.h.).
Max. speed at safe load 225 km.h. (140 m.p.h.).



The Breguet Type 763 Deux-Ponts Transport.

THE BREGUET 902 CHOUCAS.

First flown on May 14, 1957, the Type 902 is a tandem two-seat high-performance training glider of orthodox, but very simple, construction. It has a square-section fuselage and trapezoidal shoulder wings with wing-tip "salmons." No other details were available at the time of writing.

THE BREGUET 904 NYMPHALE.

The Breguet 904 is a two-seat version of the highly successful Type 901 single-seat sailplane. Two prototypes were built, the first of which made its first flight on May 26, 1956 and a series of 15 production 904's has since been completed.

The Type 904 has an NACA 63 series laminar flow-wing with an aspect ratio of 20 and with "salmons" on the tips.

DIMENSIONS.—
Span 20 m. (65 ft. 7 in.).
Length 9 m. (29 ft. 6 in.).
Height 2.5 m. (8 ft. 2½ in.).

WEIGHTS.—
Weight empty 350 kg. (772 lb.).
Weight loaded 630 kg. (1,389 lb.).

PERFORMANCE.—
Best glide ratio 37.
Min. rate of sink 0.65 m./sec. (2.13 ft./sec.) at 75 km.h. (46.6 m.p.h.).
Max. design speed 220 km.h. (137 m.p.h.).



The Breguet Type 901 High-performance Sailplane.

THE BREGUET TYPE 905 FAUVETTE.

The Type 905 is a light single-seat sailplane which has been designed to meet the F.A.I. Standard specification.

It has an NACA 63 Series laminar-flow wing with an aspect ratio of 20, and a "butterfly" tail. Considerable use is made of Klegecel, a plywood and plastic foam sandwich material which results in a very light structure.

DIMENSIONS.—
Span 15 m. (49 ft. 2 in.).
Length 6.22 m. (20 ft. 5 in.).

WEIGHTS.—
Weight empty 135 kg. (297 lb.).
Weight loaded 165 kg. (363 lb.).

BROCHET

AVIONS MAURICE BROCHET.

HEAD OFFICE AND WORKS: 12 RUE SAINT-MARTIN, NEAUPHLÉ-LE-CHATEAU (S.-ET-O.).

M. Maurice Brochet specialised originally in the design of light aircraft for the amateur constructor, and all his designs are conceived with the greatest simplicity.

Of recent Brochet aircraft, ten M.B. 70's, ten M.B. 80's, five M.B. 100's and fifteen M.B. 101's have been built for the Service de la Formation Aéronautique et des Sports Aériens (S.F.A.S.A.) for distribution among French flying clubs. All these aircraft have been illustrated and described in previous issues of this Annual.

The most recent products of the company are the M.B. 120 two-seat light cabin monoplane and the M.B. 110 four-seat touring monoplane.



The Brochet M.B. 120 (90 h.p. Continental C90 engine).

THE BROCHET M.B. 110.

Two prototypes of the M.B. 110 were ordered on October 23, 1954, at the instigation of the Service de la Formation Aéronautique et des Sports Aériens (S.F.A.S.A.). The specification called for a four-seat long-range touring aircraft, which had to be easy to build and simple to fly.

The first prototype flew for the first time on March 12, 1956.

TYPE.—Four-seat Touring monoplane.

WINGS.—High-wing braced monoplane. Göttingen 634 wing section. Aspect ratio 7.8. Chord 1.50 m. (4 ft. 11 in.) at root, 1.20 m. (3 ft. 11 in.) at tips. Dihedral 1°. Incidence 2° at root, nil at tips. All-wood two-spar structure with plywood covering. Wing braced by steel-tube streamlined V-struts on each side. Wooden mass-balanced ailerons with fabric covering. Manually-operated three-position slotted flaps of all-wood construction. Wing area 15.65 m.² (168.5 sq. ft.).

FUSELAGE.—Steel-tube structure, with plywood-covered rear decking and fabric covering overall.

TAIL UNIT.—Cantilever monoplane type. All-wood structure. Fin has plywood-covered leading-edge and fabric covering aft of spar. Tailplane is plywood-covered. Rudder and elevators are fabric-covered. Controllable trim-tabs in rudder and both elevators.

LANDING GEAR.—Fixed tail-wheel type. Adjustable metal spring shock-absorbers. Low-pressure tyres. Hydraulic brakes. Tailwheel is arranged to turn either in conjunction with the rudder or through a separate pilot-operated control. Track 2.20 m. (7 ft. 3 in.). Wheelbase 4.25 m. (13 ft. 11 in.).

POWER PLANT.—One 170 h.p. SNECMA-Régnier 4LO2 four-cylinder in-line inverted air-cooled engine, driving a two-blade Ratier-Figeac fixed-pitch metal airscrew. Fuel in four wing tanks.

ACCOMMODATION.—Enclosed cabin seating four, with two bucket-type front seats and rear bench-type seat. Dual controls. Door on each side of cabin with sliding window. Backs of front seats tip forward to give access to rear of cabin. Baggage compartment behind rear seat.

DIMENSIONS.—
Span 11.06 m. (36 ft. 4 in.).
Length 7.68 m. (25 ft. 2½ in.).
Height 2.56 m. (8 ft. 5 in.).

WEIGHTS AND LOADING.—
Weight empty 800 kg. (1,764 lb.).
Weight loaded 1,300 kg. (2,866 lb.).
Wing loading 83.30 kg./m.² (17.06 lb./sq. ft.).

PERFORMANCE.—
Max. speed 240 km.h. (149 m.p.h.).
Cruising speed 200 km.h. (124 m.p.h.).
Take-off run 220 m. (720 ft.).
Landing run 250 m. (820 ft.).
Normal range 1,000 km. (620 miles).

THE BROCHET M.B. 120.

The M.B. 120 is a two-seat light touring monoplane, the prototype of which flew for the first time on April 5, 1954. It has the airframe of the M.B. 100 remodelled as a two-seater, to which have been fitted the lighter wings, with landing-flaps, of the M.B. 80. The M.B. 120 is powered by a 90 h.p. Continental C90 flat-four engine.

DIMENSIONS.—
Span 10.66 m. (34 ft. 11 in.).
Length 6.50 m. (21 ft. 4 in.).
Height 2.0 m. (6 ft. 6 in.).

WEIGHTS AND LOADINGS.—
Weight empty 505 kg. (1,111 lb.).
Weight loaded 765 kg. (1,683 lb.).
Wing loading 52 kg./m.² (10.66 lb./sq. ft.).
Power loading 8.5 kg./h.p. (18.7 lb./h.p.).

PERFORMANCE.—
Max. speed 195 km.h. (121 m.p.h.).
Cruising speed 170 km.h. (105.5 m.p.h.).
Service ceiling 5,000 m. (16,400 ft.).
Take-off run 200 m. (218 yds.).
Landing run 180 m. (196 yds.).
Range 800 km. (500 miles).

C.A.B.

CONSTRUCTIONS AÉRONAUTIQUES DU BÉARN (C.A.B.).

HEAD OFFICE: 32, AVENUE BIÉ-MOULIÉ, PAU (BASSES-PYRÉNÉES).

WORKS: PAU-IDRON AIRPORT, PAU (BASSES-PYRÉNÉES).

This concern built the Minicab, a two-seat light cabin monoplane and the supercab, a refinement of the Minicab with a retractable landing-gear and powered by a 90 h.p. Continental engine. Both have been described and illustrated in previous editions of "All the World's Aircraft."

CENTRE EST

CENTRE EST AÉRONAUTIQUE.

HEAD OFFICE AND WORKS: 11, RUE DE DR. MAILLARD, DIJON (CÔTE D'OR).

This concern has developed, to the designs of M. R. Robin, a three-seat version of the Jodel D.11 which is known as the DR.100.

THE CENTRE EST DR.100.

The DR.100 is a three-seat light touring monoplane which has been developed from the popular two-seat Jodel monoplane. The addition of a third seat has resulted in a lengthening of the cabin and, in turn, the rear fuselage ; the centre-section span has been slightly increased, as has the track of the landing-gear, while other changes include the addition of oleo-pneumatic shock absorbers, retractable air brakes on the upper surface of the wings and a small dorsal fin. The whole airframe has been restressed to satisfy the current American C. of A. requirements for aircraft of this class.

The cabin accommodates two side-by-side with dual controls, with the third seat located centrally behind. A one-piece windscreen and a sliding canopy protect the comfortable and well-equipped cockpit. VHF radio and a radio compass are standard equipment.



The Centre Est DR.100 (90 h.p. Continental C90 engine). *(Ronald Cole).*

The DR.100 is powered by a 90 h.p. Continental C90 flat-four driving a two-blade fixed-pitch airscrew.

DIMENSIONS.—
Span 8.72 m. (28 ft. 7 in.).
Length 6.55 m. (21 ft. 6 in.).
Wing area 13.15 m.² (141.5 sq. ft.).

WEIGHTS AND LOADINGS.—
Weight empty 360 kg. (792 lb.).
Weight loaded 700 kg. (1,540 lb.).
Wing loading 53.40 kg./m.² (10.9 lb./sq. ft.).
Power loading 7.7 kg./h.p. (16.9 lb./h.p.).

PERFORMANCE.—
Max. speed 210 km.h. (130 m.p.h.).
Cruising speed 190 km.h. (118 m.p.h.).
Min. speed 60 km.h. (37 m.p.h.).
Rate of climb at S/L 180 m./min. (590 ft./min.).

DASSAULT

GENERALE AERONAUTIQUE MARCEL DASSAULT.

HEAD OFFICE : 78, QUAI CARNOT, SAINT-CLOUD (SEINE-ET-OISE).

WORKS : SAINT CLOUD (SEINE-ET-OISE), MELUN-VILLAROCHE (SEINE-ET-MARNE), ARGENTEUIL (SEINE-ET-OISE), BOULOGNE (SEINE), MERIGNAC (GIRONDE) AND TALENCE (GIRONDE).

Director-General : M. B. C. Vallières.
Technical Director : M. Henri Deplante.
Production Director : M. M. Guibert.

Générale Aéronautique Marcel Dassault, formerly the Société des Avions Marcel Dassault, is engaged in the development and production of military aircraft, aero-engines, and equipment.

The Company's principal current products are the Super-Mystère, Etendard IV-M and Mirage III-A fighters. Under development is a twin-jet eight-seat liaison aircraft named the Méditerranée.

Series production is undertaken under a widespread sub-contracting programme, with the final assembly and flight testing being handled by Dassault. The total employment of the Dassault factories is only 5,000 while some 30,000 employees of other concerns all over France are engaged in the production of Dassault parts and sub-assemblies.

Dassault is also engaged in the development and manufacture of equipment, mainly powered aircraft controls with "feel" simulation. Its electronic and telecommunications divisions are engaged on a variety of work, including research and production of weapon systems for air-to-air and surface-to-air missiles, tracking radar for use with missiles, and equipment for hypersonic jet aircraft.

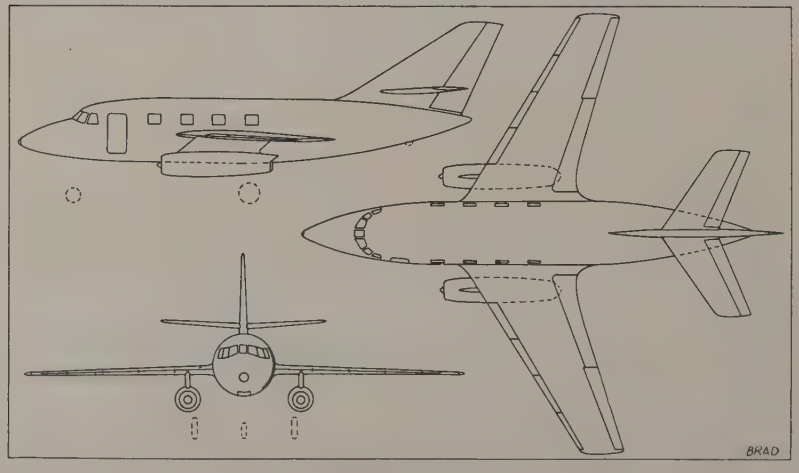
Details of the company's aero-engine activities are given in the "Gas-turbines" section of this annual.



An impression of the Dassault Méditerranée Jet Transport.

THE DASSAULT MÉDITERRANÉE.

The Méditerranée is a light civil or military transport aircraft powered by two Dassault Farandole turbojet engines (each 1,400 kg.=3,100 lb. s.t.), mounted in pods under its swept wings. It is of conventional mid-wing monoplane design, with swept tail surfaces and retractable tricycle landing gear, and is intended to carry eight or nine passengers on stages of up to 2,500 km. (1,550 miles). A prototype was under construction in 1958 ; but no further details were available for publication at the time of writing.



The Dassault Méditerranée Jet Transport.

THE DASSAULT MIRAGE III.

The Mirage III is a delta-wing supersonic aircraft which from the outset was planned with the equipment and armament necessary for fulfilling the duties of high altitude interception, fighting and tactical support from small airstrips in all weathers.

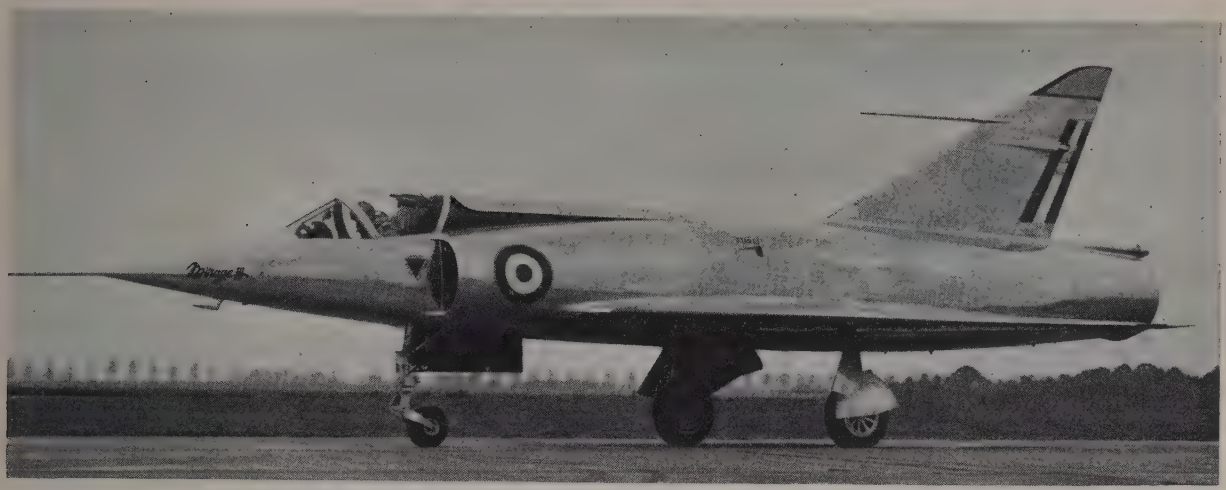
The prototype flew for the first time on November, 18, 1956, powered by a SNECMA Atar 101G turbojet with afterburner (4,500 kg.=9,900 lb. s.t.). In this form, on January 30, 1957, in the course of normal testing, it exceeded Mach 1.5 in level flight at an altitude of 1,000 m. (36,080 ft.). Later, it was fitted with an SEPR 66 auxiliary rocket motor (3,000 kg.=6,610 lb. s.t.) and reached a speed of Mach 1.9 with this in use, supplementing its turbojet. This is the equivalent of approximately 2,020 km.h. (1,255 m.p.h.).

Two developed versions of the Mirage have been announced :—

Mirage III-A. Pre-series of eight aircraft, with SNECMA Atar 9 turbojet (6,000 kg.=13,225 lb. s.t.) and SEPR 84 auxiliary rocket motor (1,500 kg.=3,300 lb. s.t.). Designed speed of Mach 2 in level flight. First Mirage III-A flew on May 12, 1958.

Mirage III-B. Two-seat version of III-A, with tandem seating under one-piece canopy. Suitable for interception or strike sorties. Loaded weight 8,400 kg. (18,500 lb.).

To increase its versatility, the possibility of launching the Mirage III from a



The Dassault Mirage III (SNECMA Atar turbojet engine and SEPR rocket motor).

ramp, identical to that used for the U.S. Martin Matador missile, is being studied. Additional thrust would be provided by two jettisonable assisted-take-off rockets developing a total of 13,000 kg. (28,660 lb.) s.t. for 2½ seconds, which would produce a 4g acceleration.

An initial production series of 100 Mirage III-A interceptors has been ordered for the French Air Force, with deliveries to start in 1960. The following details apply to this version.

TYPE.—Single-seat Interceptor fighter.

WINGS.—Cantilever low-wing monoplane of delta plan-form. Thickness/chord ratio 4.5% at root, 3.4% at tip. Aspect ratio 1.97. Sweepback on leading-edge 60°. All-metal structure. Powered ailerons with spring "feel." Air-brakes comprising small panels hinged to upper and lower wing surfaces near leading-edge. Wing area 34 m.² (366 sq. ft.).

FUSELAGE.—All-metal structure, "waisted" in accordance with the Area Rule.

TAIL UNIT.—Cantilever fin and rudder only.

LANDING GEAR.—Retractable tricycle type. Wide-track main units, with low-pressure tyres. Single wheel on all units. Braking parachute.

POWER PLANT.—One SNECMA Atar 9 turbojet engine with afterburner (6,000 kg.=13,225 lb. s.t.), plus one SEPR 84 single-chamber rocket motor (1,500 kg.=3,300 lb. s.t.). Internal fuel capacity 2,600 litre (572 Imp. gallons).

ACCOMMODATION.—Sing.e-seat under rearward-hingeing canopy, with a "knife-edge" windscreen.

ARMAMENT.—Two 30 mm. cannons or 32× 68 mm. air-to-air rockets in fuselage. Can also carry air-to-air missiles. Either Dassault Aida or Antigone fire-control radar in nose. Provision for under-wing stores.

DIMENSIONS (Prototype).—
Span 7.58 m. (24 ft. 11 in.).
Length 12.65 m. (41 ft. 6 in.).
Height 4.68 m. (15 ft. 4 in.).

DIMENSIONS (Mirage III-A).—
Span 8.20 m. (26 ft. 11 in.).

WEIGHTS AND LOADINGS (Prototype).—
Weight empty 3,500 kg. (7,715 lb.).
Weight loaded 5,000 kg. (11,025 lb.).
Wing loading 175 kg./m.² (35.84 lb./sq. ft.).
Power loading 0.85 kg./kg. s.t. (0.85 lb./lb. s.t.).

WEIGHT (Mirage III-A).—
Weight loaded 5,900-7,030 kg. (13,000-15,500 lb.).

PERFORMANCE (Mirage III-A).—
Max. speed Mach 2.
Service ceiling 25,000 m. (82,000 ft.).

THE DASSAULT ETENDARD VI.

The Etendard VI is a single-engined unpressurised swept-wing lightweight fighter which conforms to a N.A.T.O. specification for a tactical support fighter.

It has a 45° swept wing, with an anhedral of 2° 30′ and thickness/chord ratio of 6%. Internal fuel tankage comprises 2,150 litres (473 Imp. gallons) in the fuselage and 600 litres (132 Imp. gallons) in the wings. All controls are powered, and a spring "feel" unit is fitted to the one-piece tailplane. Two door-type air-brakes are fitted under the centre-section. The wheels are equipped with low-pressure tyres (4,50 kg./cm.²=64 lb./sq. in.) for operation from unprepared airfields.

Fixed armament is four 0.5 in. machine-guns, with provision for an alternative installation of two 30 mm. cannons or 55×2.75 in. rockets. In addition, there are two under-wing pylons, each of which can carry a canister of nineteen 68 mm. rockets, or up to six 60-lb. rockets, or one 1,000 lb. bomb, or a 650-litre (143 Imp. gallon) napalm tank, or a 425-litre (93.4 Imp. gallon) fuel tank.

Three prototypes, powered by the Bristol Orpheus turbojet engine, were ordered by N.A.T.O. The maiden flight of the first prototype Etendard VI, powered by an Orpheus BOr.3 (2,200 kg.=4,850 lb. s.t.), took place on March 15, 1957. A second prototype flew on September 14, 1957.

DIMENSIONS.—
Span 8.20 m. (26 ft. 11 in.).
Length 12.0 m. (39 ft. 5 in.).

THE DASSAULT ETENDARD IV.

The Etendard IV is a single-jet pressurised interceptor and ground support aircraft which has the same general airframe specification and armament as the Etendard VI, but was built to a French Air Force requirement. Two versions have been announced.

Etendard IV. Standard version, initially with SNECMA Atar 101 E4 turbojet (3,700 kg.=8,155 lb. s.t.) and armed with two 30 mm. DEFA cannons and 32×2.75 in. SNEB rockets in fuselage. Prototype flew for the first time on July 24, 1956, and was later re-engined with a SNECMA Atar 8 turbojet (4,400 kg.=9,700 lb. s.t.).

Etendard IV-M. Developed version for service in the French Navy's forthcoming new aircraft-carriers *Foch* and *Clémenceau*. Larger in size than land-based version, with SNECMA Atar 8 turbojet (4,400 kg. =9,700 lb. s.t.). Prototype flew on May 21, 1958 and work on a pre-production batch of five is in hand. The following details refer specifically to this version.

TYPE.—Single-seat Intercepter and Ground Support fighter.

WINGS.—Cantilever mid-wing monoplane. Thickness/chord ratio 6%. Sweepback 45°. All-metal two-spar structure. Tips fold for carrier stowage. Powered ailerons between folding hinges and high-lift flaps. Drooping leading-edge.

FUSELAGE.—All-metal structure, "waisted" in accordance with Area Rule. Air-brake on each side of rear fuselage.



The Dassault Etendard VI Lightweight Fighter (Bristol Orpheus turbojet engine).



The Dassault Etendard IV Ground Support Monoplane (SNECMA Atar 101E turbojet engine).

TAIL UNIT.—Cantilever monoplane type, with tailplane mid-set on fin. All surfaces swept. One-piece tailplane and rudder are power-operated.

LANDING GEAR.—Retractable tricycle type. Messier shock-absorbers with travel of 40 cm. (16 in.). All units have single wheels. Braking parachute in fairing at junction of fin and tailplane.

POWER PLANT.—One SNECMA Atar 8 turbojet engine (4,400 kg. = 9,700 lb. s.t.). Fuel in integrel tanks in wings.

PERFORMANCE (Etendard IV).—
Max. speed Mach 1.1
Climb to 12,000 m. (39,370 ft.) 5 min.
Ceiling 15,500 m. (50,850 ft.).
Take-off run 600 m. (1,970 ft.).
Landing run 400 m. (1,310 ft.).
Range 1,200 km. (750 miles).

THE DASSAULT SUPER-MYSTÈRE.

The Super-Mystère is similar in general design to the Mystère IV B but has a thinner more sharply swept wing, an improved air inlet and better cockpit visibility.

The prototype Super-Mystère B-1, fitted with a Rolls-Royce Avon RA.7 engine with afterburner, first flew on March 2, 1955, and was flown at Mach 1 in level flight on its fourth flight on the following day.

Subsequent Super-Mystères have had SNECMA Atar turbojets. Two versions have flown, as follows :—

Super-Mystère B-2. Initial production version, with SNECMA Atar 101 G turbojet (4,500 kg. = 9,900 lb. s.t.). The first pre-production B-2 flew on May 15, 1956, exceeding Mach 1 on its first flight, without using the afterburner with which it is fitted. The first production B-2 made its maiden flight on February 26, 1957. In the Spring of 1958, production was at the rate of 9 aircraft per month and delivery of the first series of 150 for the French Air Force was almost complete. A second series of 100 was scheduled to follow.

Super-Mystère B-4. Development of B-2 version, with SNECMA Atar 9 turbojet and afterburner (6,000 kg.= 13,225 lb. s.t.), giving rate of climb at sea level of 9,000 m./min. (29,500 ft./min.). Prototype flew on February 9, 1958.

Armament of the Super-Mystère comprises two 30 mm. DEFA cannons and a pack of 35 air-to-air rockets in the fuselage plus under-wing loads made up of 38

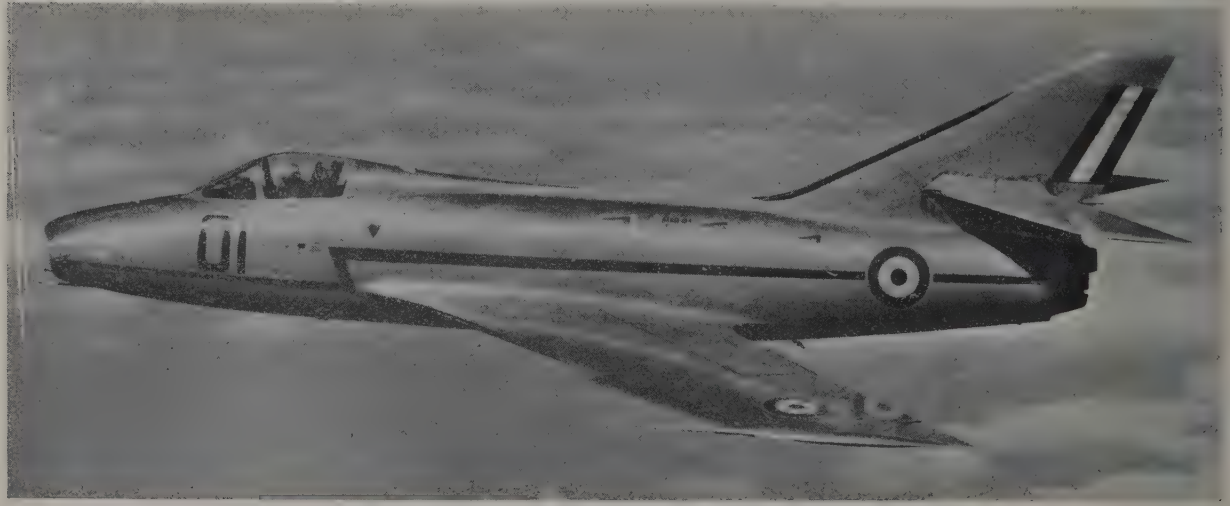


The Dassault Etendard IV-M Naval Interceptor (SNECMA Atar 8 turbojet engine).

ACCOMMODATION.—Pilot on Martin-Baker Mk. 4 lightweight ejection seat in pressurised and air-conditioned cockpit. Extensively armoured.

DIMENSIONS (Etendard IV).—
Span 9.55 m. (31 ft. 4 in.).
Length 14.0 m. (46 ft. 0 in.).
Height 4.30 m. (14 ft. 1 in.).

WEIGHTS AND LOADINGS (Etandard IV).—
Weight empty 3,400 kg. (7,495 lb.).
Weight loaded 6,500 kg. (14,330 lb.).
Wing loading 217 kg./m.² (44.44 lb./sq. ft.).
Power loading 1.75 kg./kg. s.t. (1.75 lb./lb. s.t.).



The Dassault Super-Mystère B-2 (SNECMA Atar 101G turbojet engine).

rockets in two honeycomb launchers, or two 500 kg. (1,100 lb.) bombs, or two napalm tanks, or 12 heavy air-to-surface rockets or two Matra air-to-air guided missiles. Additional fuel tanks can replace the fuselage rocket-pack and external stores.

DIMENSIONS.—
Span 10.50 m. (34 ft. 6 in.).
Length 14.04 m. (46 ft. 1 in.).

WEIGHTS (B-2).—
Weight empty 6,985 kg. (15,400 lb.).
Normal weight loaded 9,000 kg. (19,840 lb.).
Max. weight loaded 10,000 kg. (22,046 lb.).

PERFORMANCE (B-2 at 9,000 kg. = 19,840 lb. A.U.W.).—
Max. speed at 11,000 m. (36,000 ft.) 1,200 km.h. (745 m.p.h.).
Cruising speed 1,000 km.h. (620 m.p.h.).
Rate of climb 5,340 m./min. (17,500 ft./
Ceiling 17,000 m. (55,775 ft.).
Endurance 1 hour.

THE DASSAULT MYSTÈRE IV A.

Although similar in general outline to the Mystère II, which was built in quantity for the French Air Force and has been described in previous editions of this work, the IV A is a completely new aircraft. Its principal characteristics are given in the specification below.

An "off-shore" order for Mystère IV A's was placed by the U.S.A.F., followed by an order of 100 for the French Air Force. In addition, 24 were ordered by Israel and about 100 by the Indian Government, representing a total production of about 420 aircraft.

The first IV A prototype flew on September 28, 1952, and the first production aircraft was delivered in June, 1954.

TYPE.—Single-seat Interceptor or Ground Attack Fighter.

WINGS.—Low-wing cantilever monoplane. Symmetrical laminar-flow wing section. Thickness/chord ratio 7.5%. Sweepback 40° 57′ at leading-edge, 38° at 25% of chord. Dihedral — 1° 30′. All-metal structure. Split flaps between ailerons and fuselage. Gross wing area 32 m.² (344.3 sq. ft.).

FUSELAGE.—All-metal structure.

TAIL UNIT.—Cantilever monoplane type. All-metal structure. All-flying tail with hydraulic servo-controls.

LANDING GEAR.—Messier hydraulically-operated retractable nose-wheel type. Track 3.25 m. (10 ft. 8 in.).

POWER PLANT.—One Hispano-Suiza Verdon centrifugal-flow turbojet engine (3,500 kg. = 7,000 lb. s.t.). Main fuel in wings and fuselage. Auxiliary fuel in two external tanks carried beneath wings inboard of armament attachments on Alkan explosive releases. Total internal fuel 2,600 litres (572 Imp. gallons), total external fuel 1,250 litres (275 Imp. gallons).

ACCOMMODATION.—Pressurised cockpit with electrically operated sliding canopy. Ouest-Aviation ejector seat.

ARMAMENT.—Two 30 mm. cannon (150 r.p.g. each) in lower forward fuselage. Matra automatic rocket magazine containing 55 air-to-air rockets in fuselage aft of cannon installation. Attachment points under wings, with Alkan explosive releases, for two 227 kg. (500 lb.) or 454 kg. (1,000 lb.) bombs, or two 480-litre (106 Imp. gallon) Napalm containers, or two Matra rocket containers (19 air-to-air rockets each), or two groups of six air-to-ground rocket projectiles.

DIMENSIONS.—
Span 11.12 m. (36 ft. 5½ in.).
Length 12.85 m. (42 ft. 1½ in.).
Height 4.40 m. (14 ft. 5 in.).

WEIGHTS.—
Weight empty 5,680 kg. (12,496 lb.).
Weight loaded 7,500 kg. (16,535 lb.).

PERFORMANCE.
Max. speed at S/L. 1,120 km.h. (695 m.p.h.).
Max. speed at operational altitude 990 km.h. (615 m.p.h.).

DRUINE

AVIONS ROGER DRUINE.

ADDRESS: 26, AVENUE LAMORICIERE, PARIS (12e).

This company was formed by the late Roger Druine, who designed, built and flew his first aircraft at the age of seventeen and died only 20 years later, in 1958. His best-known designs are the Turbulent single-seat monoplane and the Turbi, a two-seat version of the Turbulent, both of which are available in constructional kit form.

In the United Kingdom the Popular Flying Association, which has been delegated by the A.R.B. to administer the new simplified procedure for the classification of ultra-light aircraft, is marketing sets of plans and instructions for amateur construction of the Turbulent, Turbi and the more refined Condor.

By the Spring of 1958, the P.F.A. had sold more than 100 sets of Turbulent plans and about 50 sets for the Turbi and Condor. The Turbulent is also being manufactured by Rolleson Aircraft and Engines, Ltd. of Croydon, England.



The Druine D.31 Turbulent (28 h.p. modified Volkswagen engine).

THE DRUINE D.31 TURBULENT.

The Turbulent is a conventional low-wing cantilever monoplane of wood and fabric construction which was designed primarily for the amateur constructor. It has met with considerable success and many have been built by clubs and private individuals.

TYPE.—Single-seat light monoplane.

WINGS.—Low-wing cantilever monoplane. NACA 23.012 wing section. Aspect ratio 5.4. Chord 1.20 m. (3 ft. 11 in.). Dihedral 4°. Incidence 3° 30′. Two-spar wood structure. D-type plywood leading-edge. Fabric covering aft of front spar. Built-in leading-edge slot on outer 45% of half span. Slotted ailerons have wood frames and fabric covering. Aileron area (total) 0.86 m.² (9.25 sq. ft.). Gross wing area 7.50 m.² (80.70 sq. ft.).

FUSELAGE.—Rectangular four-longeron structure with domed deck. Plywood-covered.

TAIL UNIT.—Cantilever monoplane type. All-wood frames. Fin and tailplane covered with plywood, elevators and rudder with fabric. Areas: fin 0.12 m.² (1.29 sq. ft.), rudder 0.38 m.² (4.08 sq. ft.), tailplane 0.55 m.² (5.91 sq. ft.), elevators 0.50 m.² (5.38 sq. ft.). Span of tail 2.0 m. (6 ft. 7 in.).

LANDING GEAR.—Fixed divided type. Compression-spring shock-absorbers. Mechanical motorcycle type brakes. Small orientable tail-wheel. Track 1.25 m. (4 ft. 1 in.).

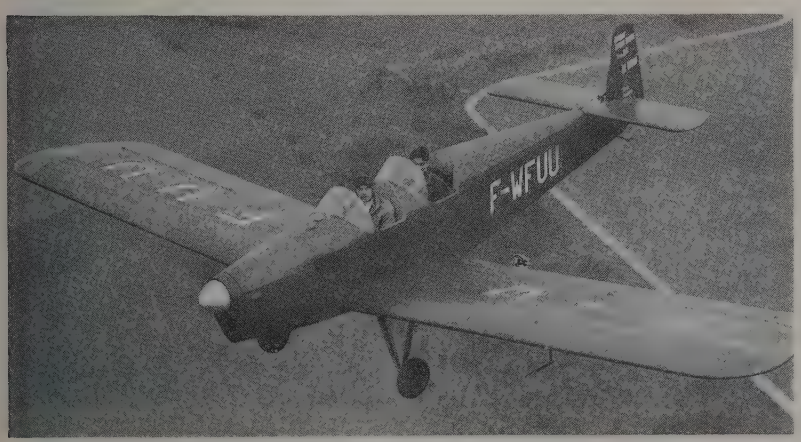
POWER PLANT.—One 30 h.p. Ardem 4 CO2 or Porsche flat-four air-cooled engine. Two-blade fixed-pitch wood airscrew. One fuel tank (40 litres = 8.8 Imp. gallons) in fuselage in front of cockpit.

ACCOMMODATION.—Single open cockpit over trailing-edge of wing. Transparent canopy optional. Space for 11.3 kg. (25 lb.) baggage behind seat.

DIMENSIONS.—
Span 6.55 m. (21 ft. 5 in.).
Length 5.30 m. (17 ft. 4½ in.).
Height 1.52 m. (4 ft. 11 in.).

WEIGHTS AND LOADINGS.—
Weight empty 155 kg. (341 lb.).
Weight loaded 278 kg. (606 lb.).
Wing loading 38.2 kg./m.² (7.82 lb./sq. ft.).
Power loading 9.9 kg./h.p. (21.5 lb./h.p.).

PERFORMANCE.—
Max. speed at S/L. 140 km.h. (87 m.p.h.).
Cruising speed 120 km.h. (74.5 m.p.h.).
Landing speed 45 km.h. (28 m.p.h.).
Initial rate of climb 150 m./min. (492 ft./min.).
Climb to 1,000 m. (3,280 ft.) 9 min.
Endurance 4.5 hours.
Take-off run 110 m. (360 ft.).



The Druine D.5 Turbi Two-seater (45 h.p. Beaussier engine).

THE DRUINE D.5 TURBI.

The Turbi is a two-seat development of the Turbulent. The prototype was designed for and fitted with the 45 h.p. Beaussier engine which is largely built up of components of the 11 h.p. Citroën automobile engine. More recently the design has been adapted to take the 65 h.p. Continental A65 flat-four or Walter Mikron four-cylinder inverted engines. One British-built version was fitted experimentally with a Coventry Victor Flying Neptune engine.

TYPE.—Two-seat light monoplane.

WINGS.—Low-wing cantilever monoplane. NACA 23012 wing section. Structure as for Turbulent. Gross wing area 12.9 m.² (139 sq. ft.).

FUSELAGE.—Rectangular four-longeron all-wood structure. Rear decking covered with fabric in early versions, but now plywood-covered.

Tail Unit.—Cantilever monoplane type. Fin built integral with fuselage. Non-adjustable tailplane. Fixed surfaces plywood-covered, movable surfaces fabric-covered.

Landing Gear.—Fixed tail-wheel type. Spring shock-absorbers. Tail-skid or tail-wheel.

Power Plant.—One 45 h.p. Beaussier 4 B02 four-cylinder inverted air-cooled engine. Merville two-blade fixed-pitch airscrew. Alternative power-plants may be the 65 h.p. Continental A65 or Walter Mikron. Fuel tank in fuselage decking in front of front cockpit.

Accommodation.—Tandem cockpits. Transparent canopy optional.

Dimensions.—
Span 8.70 m. (28 ft. 6 in.).
Length 6.86 m. (22 ft. 6 in.).
Wing area 13.50 m.² (145.2 sq. ft.).

Weights.—
Weight empty 280 kg. (610 lb.).
Weight loaded 495 kg. (1,090 lb.).

Performance (Beaussier engine).—
Max. speed 155 km.h. (96 m.p.h.).
Cruising speed 120 km.h. (74.5 m.p.h.).
Landing speed 55 km.h. (34 m.p.h.).
Initial rate of climb 150 m./min. (492 ft. min.).
Range 640 km. (400 miles).
Take-off run 160 m. (175 yds.).

THE DRUINE CONDOR.

The Condor has been designed primarily for factory production and incorporates many refinements in design and construction not found in the previously described Turbulent and Turbi. A simplified version is however available for amateur construction.

The Condor is available in the following versions :—

D.60. Prototype only. Fitted with 60 h.p. C.N.A. D4 (Italian) flat-four engine.

D.61. First production version. Powered by 65 h.p. Continental A65 flat-four engine.

D.62. Same as D.61 but fitted with 90 h.p. Continental C90 engine.

D.610. Similar to D.61 but modified to make it suitable for amateur construction and fitted with wing flaps.

D.620. Similar to D.62 but fitted with trailing-edge flaps and VHF radio.

Type.—Two-seat light monoplane.

Wings.—Low-wing cantilever monoplane. Aspect ratio 6.8. Incidence 5° at root, 3° at tip. Dihedral (upper surface) 4° 30'. Wood structure with one main spar at 30% of chord and one auxiliary spar. Leading-edge covered with plywood, remainder with fabric, with a final overall protective covering of fabric. Slotted differentially-controlled ailerons. Trailing-edge flaps on all current versions. Total area of ailerons 1.12 m.² (12.0 sq. ft.). Gross wing area 12.50 m.² (134.5 sq. ft.).



The Druine D.61 Condor (65 h.p. Continental A65 engine).

Fuselage.—All-wood structure with plywood skin and overall protective covering of fabric.

Tail Unit.—Cantilever monoplane type. Single-piece tailplane plywood-covered, with overall covering of fabric. Fin of similar construction is integral with fuselage. Wood-framed fabric-covered rudder and elevators. Areas : fin 0.32 m.² (3.4 sq. ft.), rudder 0.50 m.² (5.38 sq. ft.), tailplane 1.34 m.² (14.4 sq. ft.), elevators 0.72 m.² (7.74 sq. ft.). Span of tail 2.80 m. (9 ft. 2 in.).

Landing Gear.—Fixed tail-wheel type Cantilever shock struts with rubber-in-compression springing. Hydraulic wheel brakes. Tail-wheel with steel spring suspension and rubber cord self centering. Track 1.75 m. (5 ft. 9 in.).

Power Plant.—One 60 h.p. C.N.A. D4 (D.60 prototype) or one 65 h.p. (D.61) or 90 h.p. (D.62) Continental four-cylinder horizontally-opposed air-cooled engine. Fuel tank in fuselage behind fireproof bulkhead.

Accommodation.—Enclosed cockpit seating two side-by-side. Cabin superstructure of steel tube with single-piece windscreen and Plexiglas windows in doors, which are hinged to open upwards. Two large Plexiglas panels in cabin rear fairing. Baggage space behind seats.

Dimensions.—
Span 9.20 m. (30 ft. 2 in.).
Length 6.55 m. (21 ft. 6 in.).
Height (tail down) 1.54 m. (5 ft.).

Weights and Loadings (D.61).—
Weight empty 301.5 kg. (663 lb.).
Pilot and passenger 155 kg. (341 lb.).
Fuel and oil 43.5 kg. (96 lb.).
Weight loaded 500 kg. (1,100 lb.).
Wing loading 40 kg./m.² (8.2 lb./sq. ft.).
Power loading 7.6 kg./m.² (16.5 lb./h.p.).

Performance (D.61—65 h.p. Continental).—
Max. speed 180 km.h. (112 m.p.h.).
Cruising speed 160 km.h. (100 m.p.h.).
Landing speed 64 km.h. (40 m.p.h.).
Ceiling 4,200 m. (13,780 ft.).
Range 650 km. (400 miles).

Performance (D.62—90 h.p. Continental).—
Max. speed 220 km.h. (136 m.p.h.).
Cruising speed 195-200 km.h. (121-124 m.p.h.).
Landing speed 65 km.h. (40.3 m.p.h.).
Ceiling 5,600 m. (18,370 ft.).
Range 700 km. (435 miles).

FOUGA

POTEZ AIR-FOUGA.

Head Office : 90, Rue de Miromesnil, Paris (8e).
Works : Toulouse, Aire-sur-Adour.
Aerodrome : Toulouse-Blagnac.
Director General : W. Durodié.
Manager : Henry Potez.

In September, 1956 the five French firms Breguet, Dassault, Morane-Saulnier, Sud-Est Aviation and Ouest-Aviation formed a limited liability company, each with equal shares, to operate the aircraft works of the Etablissements Fouga. The new firm was known as Air-Fouga and it operated in this form until May 16, 1958, when it was taken over by Etablissements Henry Potez and incorporated in the Potez Group.

The works at Aire-sur-Adour, covering an area of 14,000 m.² (150,640 sq. ft.), is situated alongside an aerodrome which the company has built with the assistance of the local municipality and the State.

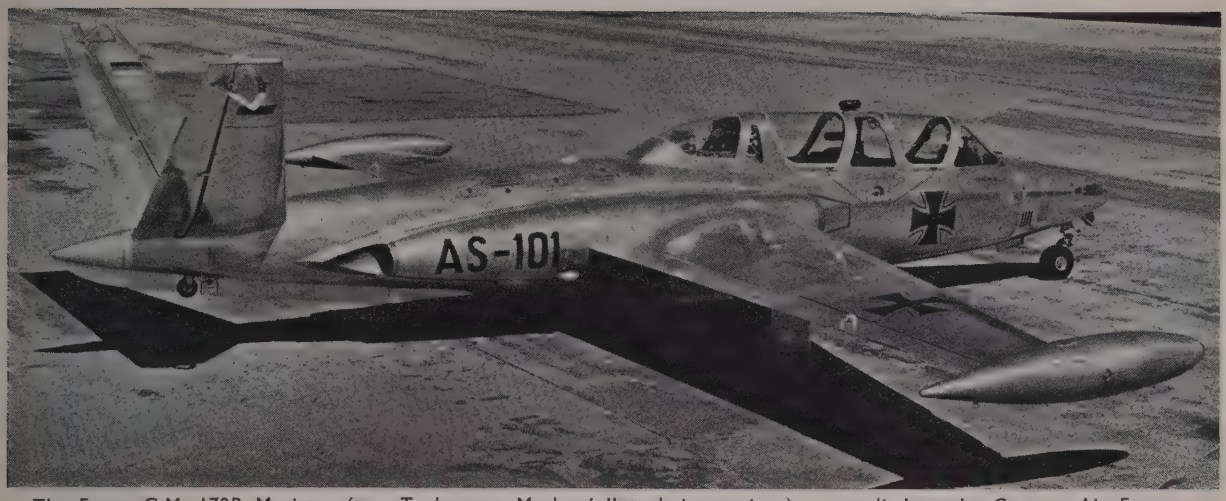
The main Fouga product is the C.M. 170R Magister twin-jet trainer which is in production for the French, Belgian (45) and German (250) Air Forces. In addition, a carrier-based version of the Magister, named the Esquif, is being built for the French Navy.

THE FOUGA C.M.170R MAGISTER.

The Magister is a light two-seat twin-jet trainer which is in production for the French Air Force. The contract for three prototypes was signed on June 27, 1951, and the first of these flew for the first time on July 23, 1952. A pre-production order for ten aircraft was placed in June, 1953 and the first aircraft of this order made its maiden flight on July 7, 1954. An order for the series production of 95 aircraft was signed on January 13, 1954, and has been increased to a total of 350 aircraft. The first production Magister flew at Toulouse on February 29, 1956 and the 100th was completed in December, 1957.



The Fouga C.M.170R Magister Trainer (two Turbomeca Marboré II turbojet engines).



The Fouga C.M. 170R Magister (two Turbomeca Marboré II turbojet engines) as supplied to the German Air Force.

The Federal German Government has ordered 250 Fouga Magisters for the new German Air Force. The first 40 complete aircraft and a considerable number of sub-assemblies are being supplied by Fouga and the first two of these were flown to Germany on May 28, 1957. The last of the 40 complete aircraft was delivered at the end of April, 1958. The remainder are being built in Germany by Flugzeug Sud-Union, which represents an association of the Heinkel and Messerschmitt companies.

On September 23, 1958, the Belgian Government placed an order for 45 Magisters for the training of Belgian and Dutch pilots, under a joint NATO training programme, at the Belgian Air Force Training Base at Kamina, Belgian Congo.

A licence to build the Magister in Israel was granted in September, 1957, to Bedek Aircraft Ltd. of Lydda Airport.

TYPE.—Light twin-jet two-seat trainer suitable for basic, intermediate and specialised training.

WINGS.—Mid-wing cantilever monoplane. NACA 64 Series wing section, thickness/chord ratio varying from 19% at root to 12% at tip. Aspect ratio 7.42. Chord 1.98 m. (6 ft. 6 in.) at root, 0.87 m. (2 ft. 10 in.) at tip. Taper ratio 0.40. No dihedral. Incidence 2°. Leading-edge sweepback 13°, trailing-edge sweep-back nil. Single-spar structure with aluminium-alloy stressed skin. Hydraulically-operated all-metal slotted high-lift flaps of area-increasing type. Automatic tabs in ailerons. All later production aircraft to have servo-control ailerons. Retractable air brakes in upper and lower surfaces. Total flap area 2.10 m.² (22.6 sq. ft.). Total aileron area 1.10 m.² (11.84 sq. ft.). Gross wing area 17.30 m.² (186.1 sq. ft.).

FUSELAGE.—Oval all-metal semi-monocoque stressed-skin structure.

TAIL UNIT.—Butterfly type, the two tapered surfaces forming an inner angle of 110°. All-metal single-spar structure. Statically and aerodynamically balanced elevators. Projected areas horizontal 3.71 m.² (40 sq. ft.), vertical 2.60 m.² (28 sq. ft.). Span of tail 4.38 m. (14 ft. 4½ in.).

LANDING GEAR.—Messier retractable nose-wheel type. Hydraulic actuation. Nose-wheel has anti-shimmy device. Messier wheels and hydraulic brakes. Wheelbase 4.49 m. (14 ft. 9 in.). Track 3.80 m. (12 ft. 6¾ in.).

POWER PLANT.—Two Turbomeca Marboré IIA turbojet engines (400 kg.=880 lb. s.t. each). Main fuel in two fuselage tanks of 255 litres (56 Imp. gallons) and 475 litres (104 Imp. gallons) capacity respectively. Total internal fuel capacity 730 litres (160 Imp. gallons). Two fixed wing-tip tanks (125 litres=27.5 Imp. gallons each) may be fitted. Oil capacity 24.4 litres (5.37 Imp. gallons).

ACCOMMODATION.—Tandem cockpits under continuous transparent canopy. Hinged sections over cockpits open upward and rearward. Pupil in front seat, instructor in rear. All flying, brake and engine controls duplicated. Emergency landing-gear and air brake controls in front cockpit only. Cockpits are pressurised and air-conditioned by SEMCA turbo-refrigeration equipment driven by air bleeds from engine compressors. Individual oxygen supply with regulator in each cockpit. VHF radio, SFR radio compass and inter-phone equipment. Blind-flying equipment.

ARMAMENT.—Two 7.5 mm. machine-guns (200 r.p.g.) in fuselage nose. Gyro gun-sight in each cockpit, that in rear cockpit fitted with additional periscopic sight. Racks for four 25 kg. (55 lb.) air-to-ground rockets, two 50 kg. (110 lb.) bombs or two Nord S.S.11 guided missiles may be fitted under each wing.

DIMENSIONS.—
Span (without tip tanks) 11.4 m. (37 ft. 5 in.).
Span (with tip tanks) 12.14 m. (39 ft. 10 in.).
Length 10.06 m. (33 ft.).
Height 2.8 m. (9 ft. 2 in.).

WEIGHTS.—
Weight empty with fixed equipment 2,150 kg. (4.740 lb.).
Normal weight loaded 3,000 kg. (6,614 lb.).
Max. permissible A.U.W. 3,200 kg. (7,055 lb.).

PERFORMANCE.—
Max. speed at S/L at 2,700 kg. (5,953 lb.) A.U.W. 650 km.h. (404 m.p.h.).
Max. speed at 7,000 m. (22,950 ft.) at 2,700 kg. (5,953 lb.) A.U.W. 655 km.h. (407 m.p.h.).
Max. rate of climb at S/L at 2,920 kg. (6,437 lb.) A.U.W. 1,020 m./min. (3,345 ft./min.).
Climb to 6,000 m. (19,700 ft.) at 2,920 kg. (6,437 lb.) A.U.W. 10 min.
Service ceiling 12,000 m. (39,370 ft.).
Take-off run at 2,920 kg. (6,437 lb.) A.U.W. 580 m. (1,900 ft.).
Take-off distance to clear 15.25 m. (50 ft.) at 2,920 kg. (6,437 lb.) A.U.W. 880 m. (2,890 ft.).
Landing distance from 15.25 m. (50 ft.) at 3,070 kg. (6,765 lb.) A.U.W. 820 m. (2,690 ft.).



The Fouga C.M. 175 Esquif Naval Trainer (two Turbomeca Marboré turbojet engines).

THE FOUGA C.M. 175 ESQUIF.

The Esquif is a naval trainer version of the Magister. Two prototypes and 30 production aircraft have been ordered by the French Navy.

The Esquif is generally similar to the Magister but incorporates certain modifications to meet naval requirements. These include catapult equipment, arrester gear and two separate rearward-sliding hoods for the crew. The strengthened Messier undercarriage is 0.15 m. (6 in.) longer than on the Magister but is compressed during retraction so that the wheel-wells have not had to be modified.

The first prototype Esquif flew for the first time on July 31, 1956, and underwent simulated deck-landing trials at the R.A.E. Bedford, later in that year. Both prototypes have since completed full-scale deck trials in H.M.S. *Bulwark* and *Eagle*.

The production Esquif will be used as a deck-landing and fighter trainer. The first was scheduled to fly in November, 1958.

TYPE.—Light twin-jet Carrier-based trainer.

WINGS, FUSELAGE AND TAIL UNIT.—Basically similar to those of Magister. Wings do not fold.

LANDING GEAR.—Basically same as for Magister, but long-stroke Messier oleo-pneumatic shock-absorbers compress during retraction. Kleber Colombe 10HP wheels and Dunlop 04 tyres. Messier hydraulic brakes. Wheel track 3.80 m. (12 ft. 6¾ in.). Wheelbase 4.70 m. (15 ft. 5 in.).

POWER PLANT.—Two Turbomeca Marboré IIB turbojet engines (400 kg.=880 lb. s.t. each). Otherwise as for Magister, except smaller fuselage fuel tanks has capacity of only 235 litres (51.7 Imp. gallons) compared with 255 litres (56 Imp. gallons) on Magister.

ACCOMMODATION.—Basically same as for Magister, but with separate rearward-sliding canopy over each seat. Controls for emergency landing gear release, flaps, air-brakes, brakes and arrester hook in front cockpit only.

ARMAMENT.—Same as for Magister.

DIMENSIONS.—
Same as for Magister, except
Height 2.95 m. (9 ft. 8 in.).

WEIGHTS.—
Weight empty, equipped 2,350 kg. (5,180 lb.).
Normal loaded weight 3,200 kg. (7,055 lb.).
Max. permissible loaded weight 3,400 kg. (7,495 lb.).
Max. landing weight 3,100 kg. (6,635 lb.).

PERFORMANCE.—
Max. speed at S/L 630 km.h. (392 m.p.h.).
Max. speed at 7,000 m. (22,950 ft.) 649 km.h. (403 m.p.h.).
Landing speed 167 km.h. (104 m.p.h.).
Min. catapult speed at max. A.U.W. 176 km.h. (109 m.p.h.).
Rate of climb at S/L 900 m./min. (2,950 ft./min.).

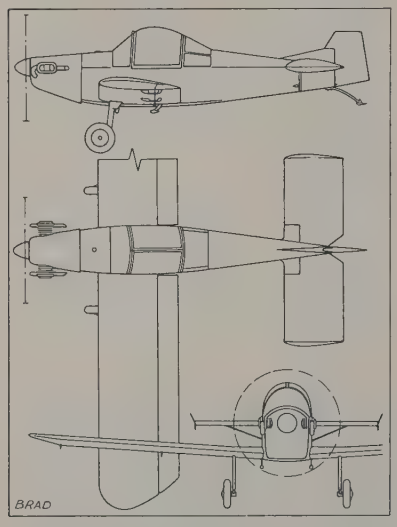
GATARD

MONSIEUR GATARD.

ADDRESS: 6, RUE GUYNEMER, ST. JEAN D'ANGELY (CHARENTE-MARITIME).

M. Gatard is developing a new control system for aeroplanes, which involves the use of a variable-incidence lifting tailplane of large area, and has built two light aircraft named the Statoplan 01 and 02 incorporating his ideas. It is planned to offer the 02 for amateur construction.

Instead of altering the wing angle of attack to increase lift on these aircraft, the pilot lowers full-span slotted flaps and adjusts the tailplane to maintain pitching equilibrium. In consequence, the aircraft climb with the fuselage datum at no more than 4° to the horizontal, which preserves a good forward view and low body drag.



The Gatard Statoplan 02.



The Gatard Statoplan 01 (32 h.p. Poisard engine). (*Ronald Cole*).

THE GATARD STATOPLAN 01.

TYPE.—Two-seat Ultra-light monoplane.

WINGS.—Strut-braced high-wing monoplane. NACA 23012 wing section. Wood structure. Full-span slotted flaps retain sufficient differential action throughout range of depression to ensure adequate lateral control. Linkage also ensures correct relative flap and tailplane angles. Wing area 9.0 m.² (96.9 sq. ft.).

FUSELAGE. Conventional plywood-covered wood structure.

TAIL UNIT.—Braced monoplane type with variable-incidence all-moving tailplane of NACA 23010 section. Wood structure. No elevators.

LANDING GEAR.—Non-retractable two-wheel type. Rubber-spring main units. Tail-skid.

POWER PLANT.—One 32 h.p. Poinsard two-cylinder horizontally-opposed air-cooled engine, driving two-blade fixed-pitch airscrew.

ACCOMMODATION.—Two-seats in tandem in enclosed cabin.

DIMENSIONS.—
Span 8.0 m. (26 ft. 3 in.).
Length 4.60 m. (15 ft. 1 in.).

WEIGHTS.—
Weight empty 200 kg. (440 lb.).
Weight loaded 360-380 kg. (794-838 lb.).

PERFORMANCE.—
Max. speed 138 km.h. (86 m.p.h.).
Cruising speed 105 km.h. (65 m.p.h.).
Landing speed 40-45 km.h. (25-28 m.p.h.).
Duration more than 3 hours.



The Gatard Statoplan 02 (26 h.p. Volkswagen engine). (*Ronald Cole*).

THE GATARD STATOPLAN 02.

TYPE.—Single-seat Ultra-light monoplane.

WINGS.—Cantilever low-wing monoplane. NACA 23012 wing section. Plywood-covered all-wood structure. Full-span slotted flaps as on 01. Wing area 6.0 m.² (64.6 sq. ft.).

FUSELAGE. Conventional plywood-covered wood structure.

TAIL UNIT.—Braced monoplane type with variable-incidence all-moving tailplane of NACA 23010 section. Wood structure. End-plates fitted to tailplane to increase vertical fin area and effective tailplane span. No elevators. Area of tailplane 1.5 m.² (16.2 sq. ft.).

LANDING GEAR.—Non-retractable two-wheel type. Cantilever levered-suspension type main units with rubber band shock-absorption. Tail skid.

POWER PLANT.—One 26 h.p. modified Volkswagen four-cylinder horizontally-opposed air-cooled engine, driving two-blade fixed-pitch airscrew.

ACCOMMODATION.—Single-seat, under large rearward-sliding blister-type canopy.

DIMENSIONS.—
Span 6.0 m. (19 ft. 8 in.).
Length 4.25 m. (13 ft. 11 in.).

WEIGHT.—
Weight loaded 280 kg. (617 lb.).

PERFORMANCE.—
Max. speed 145 km.h. (90 m.p.h.).
Rate of climb at S/L 180 m./min. (590 ft./min.).

HUREL-DUBOIS



The Hurel-Dubois H.D. 321 Transport (two 1,525 h.p. Wright engines).

SOCIÉTÉ DE CONSTRUCTION DES AVIONS HUREL-DUBOIS.

Head Office and Works: Route de Verrières, Meudon-Villacoublay (Seine-et-Oise).

Avions Hurel-Dubois was formed to develop and put into practice the theories of M. Hurel regarding the advantages of using wings of high aspect ratio. Theoretical studies and wind-tunnel tests had shown that the aspect ratio of a monoplane wing could be doubled or even trebled when the wing was braced with suitably designed lift struts, without any increase in structure weight, thereby allowing an increase in all-up weight and a considerable increase in useful load with the same power.

The company's first product, the H.D. 10 experimental monoplane, completed its trials with success and as a result the French Government ordered two twin-engined aircraft of the same general configuration. The first, the H.D. 31, made its first flight on January 27, 1953, and the second, the higher-powered H.D. 32, on December 29, 1953. A second H.D. 32 prototype made its maiden flight on February 11, 1955.

Both prototypes of the H.D. 32 were later re-engined with two 1,525 h.p. Wright 982 engines and re-designated the H.D. 321-01 and H.D. 321-02 respectively. One was lost when a wing entered the water during a bank over Rio de Janeiro Bay in poor visibility on October 30, 1956.

Two orders for a total of eight developed H.D. 34's have been received from the Institut Géographique National, and the first of these flew on February 26, 1957. The first four aircraft were delivered to the I.G.N. at the end of 1957 and were put into service early in 1958. The second four will be delivered during the course of 1958.

In conjunction with Avions Hurel-Dubois, the British company of F. G. Miles, Ltd. has fitted an Hurel-Dubois type of wing to an Aerovan light freight aircraft for evaluation, under the designation H.D.M. 105. A description of this aircraft appears under "Miles" in the British section of this annual.

THE HUREL-DUBOIS H.D. 321.

The H.D. 321 is the production version of the H.D. 32 prototypes, which originally had two 1,200 h.p. Pratt & Whitney R-1830-92 engines. The first H.D. 321 made its first flight on December 22, 1955.

Type.—Twin-engined Cargo-carrying monoplane.

Wings.—High-wing braced monoplane. Aspect ratio 20.2. Wing in three sections, a rectangular centre-section and two tapering detachable outer sections. Centre-section chord 2.4 m. (7 ft. 10½ in.). Outer wings braced with single lift struts attached at their inner ends to small wing stubs which are also braced to the engine nacelles. Conventional ailerons with automatic tab in port aileron and controllable tab in starboard. Two spoiler surfaces with controls synchronised with that of ailerons. Double-slotted Fowler-type flaps. Entire wing of all-metal construction. Gross wing area 100 m.² (1,076 sq. ft.).

Fuselage.—All-metal structure.

Tail Unit.—Cantilever monoplane type with main fin faired into fuselage by a long dorsal fin, and two auxiliary fins mounted on the tailplane. All-metal structure. Statically and aerodynamically balanced control surfaces. Elevator control surfaces in four parts, two inboard with full-span tabs, and two outboard. Rudder in two parts, lower with full-span tab and horn-balanced, upper with half-span tab. Total area of horizontal surfaces 24.5 m.² (264 sq. ft.), of vertical surfaces 24.2 m.² (260 sq. ft.).

Landing Gear.—Messier fixed tricycle type. All five wheels and low-pressure tyres are identical. Main shock-absorber struts in fairings between ends of small stub wings and engine nacelles. Paired main wheels enclosed in easily removable fairings which have ducted cooling for wheel brakes. Rear portions of shock strut fairings are hinged to serve as air-brakes. Steerable nose-wheel in readily removable fairing. Main wheel track 7 m. (22 ft. 11½ in.).

Power Plant.—Two 1,525 h.p. Wright 982 C9 HE1 nine-cylinder radial air-cooled engines. Hamilton Standard constant-speed feathering airscrews. All fuel in wings. In each wing there are three 500 litre (110 Imp. gal.) and one 300 litre (66 Imp. gal.) tanks which supply engine through a 65 litre (14.4 Imp. gal.) auxiliary tank in engine nacelle. Cross-feed for each engine to be fed, if necessary, from opposite wing tanks.

Accommodation.—Provision for crew of three, pilot and co-pilot side-by-side with dual controls, and navigator/radio-operator behind the second pilot. Crew compartment heated and soundproofed. The unobstructed main cabin may carry either freight or passengers, or mixed load. Cabin dimensions: length 12.98 m. (42 ft. 6 in.), width at floor 2.2 m. (7 ft. 2½ in.), height above floor 2.14 m. (7 ft. 0 in.), volume above floor 58 m.³ (2,115 cub. ft.), volume usable for freight, with gangway provision, 40.8 m.³ (1,441 cub. ft.), height of cabin floor above ground 1.07 m. (3 ft. 6 in.). Main cargo loading door 2 m. × 2 m. (6 ft. 6 in.) square on port side aft of wing. A small door on same side forward of wing for crew and passengers. Freight holding-down rings in floor and sides of fuselage with necessary harness, etc. Up to 44 passengers may be carried.

Dimensions.—
Span 45.3 m. (148 ft. 7½ in.).
Length 23.27 m. (76 ft. 4 in.).
Height 8.73 m. (28 ft. 7½ in.).

Weights and Loadings.—
Weight empty 11,112 kg. (24,498 lb.).
Payload (500 km. (310 mile) stage, without reserves) 6,490 kg. (14,308 lb.).
Payload (1,000 km. (620 mile) stage, without reserves) 5,910 kg. (13,030 lb.).
Gross take-off weight 18,700 kg. (41,200 lb.).
Wing loading 187 kg./m.² (38.4 lb./sq. ft.).
Power loading 6.14 kg./h.p. (13.53 lb./h.p.).

Performance.—
Cruising speed (54.8% rated power) 275 km.h. (172 m.p.h.).
Stalling speed 120 km.h. (74.6 m.p.h.).
Rate of climb at S/L. 287 m./min. (940 ft./min.).
Rate of climb at S/L., one engine out, 77 m./min. (252 ft./min.).
Take-off field length 1,100 m. (3,609 ft.).
Landing distance from 15 m. (50 ft.) at full A.U.W. 570 m. (1,870 ft.).
Max. range 2,200 km. (1,370 miles).

THE HUREL-DUBOIS H.D. 322.

The H.D. 322 is a military project developed from the H.D. 321. Fitted with a rear loading door and ramp, this version would be able to accommodate 60 fully armed and equipped troops, 32 stretcher cases, or various types of transport vehicles to a weight of 6 tonnes.

THE HUREL-DUBOIS H.D. 34.

The type number H.D. 34 has been given to a version of the H.D. 321 which has been specially developed as a photographic aircraft meeting the requirements of the Institut Géographique National.

The H.D. 34 has a slightly longer front fuselage which accommodates a photographer/navigator's post in the



The Hurel-Dubois H.D. 34 Photographic aircraft as supplied to the Institut Géographique National.

extreme nose. The twin-wheel nose landing gear is mounted off-centre and is retractable.

The H.D. 34 carries two vertical cameras with 32 spare reels of film, each weighing 68 kg. (150 lb.), and two oblique cameras. It has a crew of five, including two camera operators. Fuel capacity is increased to 6,400 litres (1,410 Imp. gallons).

In all other respects the two aircraft are similar. The performance of the H.D. 34 is the same as that guaranteed for the H.D. 321.

JODEL

SOCIÉTÉ DES AVIONS JODEL.

HEAD OFFICE AND WORKS: ROUTE DE SEURRE, BEAUNE (CÔTE-D'OR).

The Société des Avions Jodel was formed in March, 1946, by MM. Jean Delemontez and Edouard Joly, with the former acting as business and technical manager and the latter as test pilot.

Its first activities were concerned with the repair of gliders and light aircraft of the Service d'Aviation Légère et Sportive on behalf of the State.

In the meantime the company designed and built the D.9 single-seat light monoplane, the Bébé Jodel, which made its first flight in January, 1948. This aeroplane, which has received its airworthiness certificate with various power-plants, is intended for the amateur constructor.

As the result of official tests with the D.9, the French authorities placed an order for the development and construction of two prototypes of a two-seat model, the D.11, fitted with the 45 h.p. Salmson, and the D.111, fitted with the 75 h.p. Minié engine. Subsequent developments of the D.11 are the D.112 and D.117, which have a 65 h.p. and 90 h.p. Continental engine respectively.

Many hundreds of kits of the single-seat Bébé Jodel and of the two-seat models have been delivered to purchasers in all parts of the World.

Several French companies are undertaking the licence manufacture of standard or developed versions of the Jodel monoplane. These are :—

Centre Est Aéronautique, Dijon (Côte d'Or).
Is building a small series of a three-seat version known as the DR.100 (see under "Centre Est").

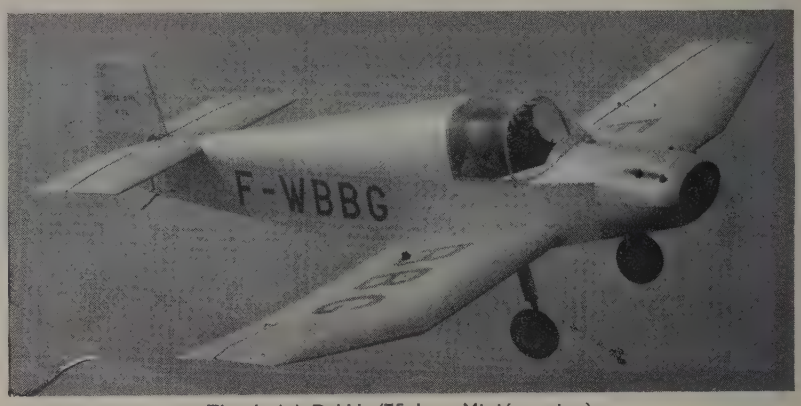
Etablissements Renard, Angers (M-et-L).
Is building a small series of the two-seat D.111.

Société Aéronautique Normande, Bernay (Eure).
Is building under licence the D.117 Grand Tourisme and has developed and is responsible for the production of the D.140 Mousquetaire (see under "Normande").

Société Passot Aviation, Macon-Charnay (S-et-L).
Is building small series of the D.112 (65 h.p. Continental) and the D.119 (90 h.p. Continental).

Société Wassmer, Paris (20e).
Is building under licence the D.112 (65 h.p. Continental) and is solely responsible for the production of the *de luxe* D.120 Paris-Nice (see under "Wassmer").

In addition, various versions of the D.9 and the D.112 have been produced by the Pasotti company in Italy, Aero Flugzeugbau Hubert Zuerl in Germany and Aero-Difusión S.L. in Spain.



The Jodel D.111 (75 h.p. Minié engine).

THE JODEL D.9 BÉBÉ.

TYPE.—Single-seat Light monoplane.
WINGS.—Low-wing cantilever monoplane. Single-spar one-piece wing with wide-span centre-section of constant chord (1.80 m.= 5 ft. 10 in.) and thickness and two tapering outer portions set at a coarse dihedral angle (14°). Spar and ribs of spruce and plywood with fabric covering. Ailerons on outer portions. Gross wing area 9 m.² (96.8 sq. ft.).
FUSELAGE.—Rectangular spruce and plywood structure.
TAIL UNIT.—Cantilever monoplane type. No fin. Spruce and plywood frames with plywood-covered tailplane and fabric-covered rudder and elevators.
LANDING GEAR.—Divided type. Cantilever legs with rubber-in-compression springing. Leaf spring tail-skid. Cable-brakes.
POWER PLANT.—One 26 h.p. Volkswagen flat-four air-cooled engine. Fuel tank in fuselage.
ACCOMMODATION.—Single open cockpit.
DIMENSIONS.—
Span 7 m. (22 ft. 11 in.).
Length 5.45 m. (17 ft. 10½ in.).
WEIGHTS.—
Weight empty 162 kg. (356 lb.).
Disposable load 110 kg. (242 lb.).
Weight loaded 272 kg (598 lb.).
PERFORMANCE.—
Max. speed 150 km.h. (93 m.p.h.).
Cruising speed 130 km.h. (81 m.p.h.).
Landing speed 50 km.h. (31 m.p.h.).
Initial rate of climb 126 m./min. (412 ft./min.).
Take-off run 110 m. (120 yds.).
Landing run 60 m. (66 yds.).
Range 460 km. (286 miles).

THE JODEL D.11.

The D.11 is a two-seat dual-control version of the D.9. Except for increased overall dimensions, a wider fuselage and enclosed side-by-side cockpit, the D.11 conforms in layout and structure to the D.9. The D.11, which is fitted with a 45 h.p. Salmson radial engine, is also being marketed in kit form.

DIMENSIONS.—
Span 8.2 m. (26 ft. 10 in.).
Length 6.2 m. (20 ft. 4 in.).
Height 2.05 m. (6 ft. 9 in.).
Wing area 12.7 m.² (136.6 sq. ft.).
WEIGHTS.—
Weight empty 270 kg. (594 lb.).
Disposable load 215 kg. (473 lb.).
Weight loaded 485 kg. (1,067 lb.).
PERFORMANCE.—
Max. speed 170 km.h. (105.5 m.p.h.).
Cruising speed 155 km.h. (96 m.p.h.).
Landing speed 65 km.h. (40.3 m.p.h.).
Initial rate of climb 140 m./min. (460 ft./min.).
Take-off run (no wind) 160 m. (175 yds.).
Take-off to 20 m. (66 ft.) 360 m. (395 yds.).
Landing run 80 m. (85 yds.).
Range 600 km. (375 miles).

THE JODEL D.111.

The D.111 is identical to the D.11 except that it is fitted with a 75 h.p. Minié flat-four engine. A small series of the D.111 is under construction.

DIMENSIONS.—
Same as D.11 except :
Length 6.28 m. (20 ft. 7 in.).
WEIGHTS.—
Weight empty 280 kg. (616 lb.).
Weight loaded 520 kg. (1,144 lb.).
PERFORMANCE.—
Max. speed 200 km.h. (124 m.p.h.).
Max. cruising speed 170 km.h. (105.5 m.p.h.).
Economic cruising speed 155 km.h. (96 m.p.h.).
Landing speed 65 km.h. (40.3 m.p.h.).
Rate of climb 220 m./min. (720 ft./min.).
Take-off run (no wind) 90 m. (98 yds.).
Take-off to 20 m. (66 ft.) 260 m. (284 yds.).
Landing run 90 m. (98 yds.).
Range 700 km. (435 miles).

THE JODEL D.112 CLUB.

The D.112 is the D.11 fitted with a 65 h.p. Continental flat-four engine.

DIMENSIONS.—
Span 8.2 m. (26 ft. 10 in.).
Length 6.36 m. (20 ft. 10 in.).
WEIGHTS.—
Weight empty 300 kg. (660 lb.).
Weight loaded 530 kg. (1,166 lb.).
PERFORMANCE.—
Max. speed 180 km.h. (112 m.p.h.).
Max. cruising 170 km.h. (105.5 m.p.h.).
Economic cruising 150 km.h. (93 m.p.h.).
Landing speed 65 km.h. (40.3 m.p.h.).
Rate of climb 175 m./min. (575 ft./min.).
Take-off run (no wind) 220 m. (240 yds.).
Take-off to 20 m. (66 ft.) 300 m. (328 yds.).
Landing run 150 m. (164 yds.).
Range 530 km. (330 miles).



The Jodel D.112 Club (65 h.p. Continental engine). (*Ronald Cole*).

THE JODEL D.117 GRAND TOURISME.

Basically similar to the Jodel D.11, but powered by a 90 h.p. Continental C90-14F engine, the D.117 is being produced by the Société Aéronautique Normande. A full description appears under the entry for that company.

THE JODEL D.120 PARIS-NICE.

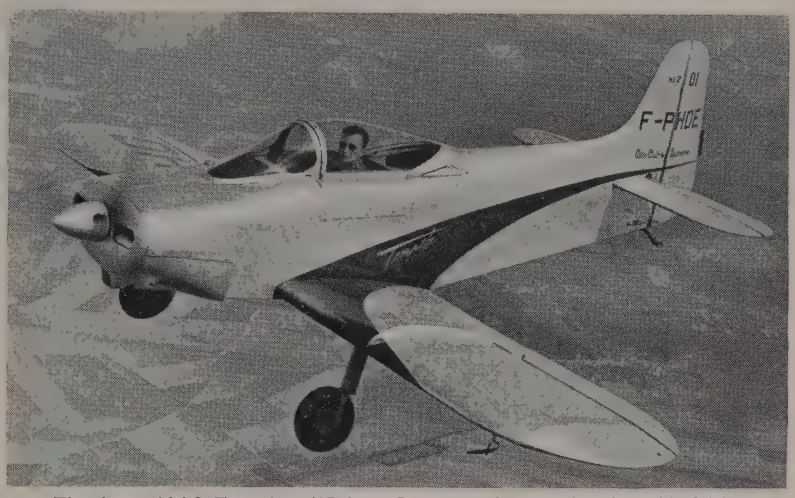
The Paris-Nice is a de-luxe version of the D.112 with 90 h.p. Continental C90 engine, which is being built in quantity by Etablissements Wassmer. Further details will be found under the entry for that company.

JURCA

MARCEL JURCA.

ADDRESS : 2, RUE DES CHAMPS PHILIPPE, LA GARENNE-COLOMBES (SEINE).

Under the direction of M. Marcel Jurca, a young ex-military pilot and electrical engineer, the members of the Aero Club of Courbevoie have built the M.J.2 Tempête single-seat light aircraft, which incorporates many Jodel components. The prototype first flew on June 27, 1956. Sets of drawings of the M.J.2 are now available for home construction. Five sets have been sold to amateur builders in the United States and Canada and it was expected that the five Tempêtes would be ready to fly in the New World by the end of 1958.



The Jurca M.J.2 Tempête (65 h.p. Continental engine). (*Ronald Cole*).

THE JURCA M.J.2 TEMPÊTE.

TYPE.—Single-seat Light monoplane.

WINGS.—Low-wing cantilever monoplane. NACA 23012 wing section. Aspect ratio 4.5. Chord 1.40 m. (4 ft. 7 in.). Incidence 4° at root, 2° at tip. No dihedral. All-wood one-piece single-spar structure with fabric covering. Fabric-covered wooden ailerons. Total area of ailerons 1.0 m.² (10.76 sq. ft.). Wing area 7.98 m.² (85.90 sq. ft.).

FUSELAGE.—All-wood structure of basic rectangular section, plywood-covered.

TAIL UNIT.—Cantilever monoplane type. All-wood structure. Tailplane and fin plywood-covered, elevators and rudder fabric-covered. Trim-tab on starboard elevator. Areas : fin 0.645 m.² (6.94 sq. ft.), rudder 0.54 m.² (5.81 sq. ft.), tailplane 0.85 m.² (9.15 sq. ft.), elevators 0.80 m.² (8.61 sq. ft.). Tailplane span 2.50 m. (8 ft. 2 in.).

LANDING GEAR.—Non-retractable two-wheel type. Jodel D.112 cantilever legs with rubber-in-compression springing. Jodel D.112 wheels and Dunlop 420 × 150 tyres. No brakes. Jodel D.112 tail-skid. Wheel track 2.30 m. (7 ft. 6½ in.).

POWER PLANT.—One 65 h.p. Continental A65 four-cylinder horizontally-opposed air-cooled engine, driving Merville two-blade fixed-pitch wooden airscrew. Provision for fitting 75, 85 or 90 h.p. Continental engine. Jodel engine-mounting and cowling. Jodel fuel tank, capacity 60 litres (13.2 Imp. gallons) aft of firewall in fuselage.

ACCOMMODATION.—Single seat under long rearward-sliding transparent canopy. Provision for parachute.

DIMENSIONS.—
Span 6.0 m. (19 ft. 8 in.).
Length 5.7 m. (18 ft. 8½ in.).
Height 2.4 m. (7 ft. 10 in.).

WEIGHTS AND LOADINGS.—
Weight loaded 400 kg. (882 lb.).
Wing loading 50 kg./m.² (10.24 lb./sq. ft.).
Power loading 6.1 kg./h.p. (13.45 lb./h.p.).

PERFORMANCE.—
Max. speed 193 km.h. (120 m.p.h.).
Cruising speed 170 km.h. (106 m.p.h.).
Landing speed 80 km.h. (50 m.p.h.).
Rate of climb 170 m./min. (555 ft./min.).
Service ceiling 3,500 m. (11,500 ft.).
Endurance 3 hr. 20 min.

LEDUC

RENÉ LEDUC ET FILS.

HEAD OFFICE AND WORKS : 158, QUAI DE BEZONS, ARGENTEUIL (SEINE-ET-OISE).

René Leduc had for many years concentrated on the development of the "athodyd" or ramjet type of power-plant for aircraft. As far back as 1935 he was successful in producing a small unit which developed a thrust of 4 kg. (8.8 lb.) at 300 m./sec. (985 ft./sec.).

His first complete ramjet-driven aircraft was the 0.10 monoplane, which has been described fully in earlier editions of "All the World's Aircraft."

Two prototypes of the larger Leduc O.21 were next built, the first making its initial flight from a carrier aircraft on May 16, 1953. These aircraft proved completely successful and were used to flight test components and equipment of the O.22 supersonic version which was intended to be a prototype for a ramjet-powered Mach 2 interceptor.

The first of two O.22 prototypes made its first flight on December 26, 1956. This version, larger than the O.21, was fitted with a SNECMA Atar turbojet engine within the body of the athodyd to enable it to take off under its own power.

Both the O.21 and O.22 were developed to the order of the French Air Ministry, but official support was withdrawn under the 1957 "cut-back" in military contracts and development has now ceased. Both the O.21 and O.22 have been illustrated and described in previous editions of this Annual.

LEGRAND-SIMON

PAUL LEGRAND.

ADDRESS : 147, AVENUE J. B. CLÉMENT, CLAMART (SEINE).

A two-seat light monoplane known as the LS.50 Dauphine has been designed and built by M. Simon, a young engineer with the Breguet company, and Paul Legrand, who is with the SNECMA organisation, as a prototype for a light economical touring, training and glider-towing aircraft. It flew for the first time on January 13, 1957, and has since been awarded its Airworthiness Certificate.

THE LEGRAND-SIMON LS.50 DAUPHINE.

TYPE.—Two-seat Light monoplane.

WINGS.—Braced high-wing monoplane. Wing section NACA 23012. Aspect ratio 7. Incidence 4° 45′ at root, 1° 45′ at tip. Dihedral 1°. Single-spar structure with D-type plywood torsion-box leading-edge, ribs aft of spar and overall fabric covering. Slotted flaps inboard of ailerons. Total area of flaps 1.8 m.² (19.4 sq. ft.). Total area of ailerons 1.2 m.² (12.9 sq. ft.). Gross wing area 13.5 m.² (145.3 sq. ft.).

FUSELAGE.—Rectangular wooden structure. Welded steel tube cabane attached to fuselage at six points forms upper framework of cabin and carries wing spar attachments. A metal cross girder in form of inverted U at bottom of cabin section carries attachment points for wing bracing struts, landing-gear legs and springing, seats and controls.

TAIL UNIT.—Braced monoplane type. Welded steel tube framework covered with fabric. Balanced rudder and elevator with trim tabs.

LANDING GEAR.—Fixed tail-wheel type. Side vees articulated and sprung internally by rubber cord. Fully-swivelling tail-wheel.

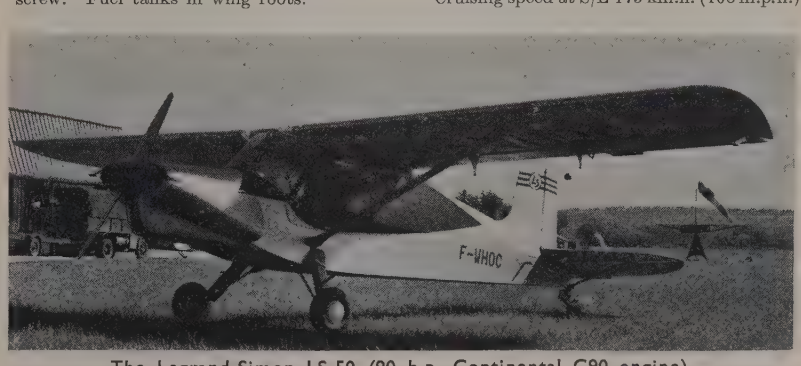
POWER PLANT.—One 90 h.p. Continental C90 four-cylinder horizontally-opposed air-cooled engine. Two-blade fixed-pitch airscrew. Fuel tanks in wing roots.

ACCOMMODATION.—Enclosed cabin seating two side-by-side with dual controls. Doors on each side.

DIMENSIONS.—
Span 9.66 m. (31 ft. 8 in.).
Length 6.42 m. (21 ft.).
Height (tail down) 2.08 m. (6 ft. 10 in.).

WEIGHTS AND LOADINGS.—
Weight empty 458 kg. (1,008 lb.).
Weight loaded 720 kg. (1,584 lb.).
Wing loading 53.3 kg./m.² (10.92 lb./sq. ft.).
Power loading 8 kg./h.p. (17.6 lb./h.p.).

PERFORMANCE.—
Max. speed at S/L 195 km.h. (121 m.p.h.).
Cruising speed at S/L 175 km.h. (108 m.p.h.).



The Legrand-Simon LS-50 (90 h.p. Continental C90 engine).

Cruising speed at 1,000 m. (3,280 ft.) 170 km.h. (105.5 m.p.h.).
Min. speed without flaps 83 km.h. (51.5 m.p.h.).
Min. speed with max. flap (30°) 70 km.h. (43.4 m.p.h.).
Landing speed with max flap 66 km.h. (41 m.p.h.).
Rate of climb at S/L 220 m./min. (720 ft./min.).
Service ceiling 5,300 m. (17,385 ft.).
Range 1,000 km. (620 miles).

MAX HOLSTE

SOCIÉTÉ DES AVIONS MAX HOLSTE.

HEAD OFFICE AND WORKS: 11 RUE GOSSET, REIMS.

President and General Director: Max Holste.

Most important product of Avions Max Holste is the M.H. 1521 Broussard, the prototype of which first flew on November 17, 1952. The company is now engaged in fulfilling orders for 335 for the French Armed Services, and for a further 50 or so to meet various non-military orders. The first production M.H. 1521 flew on June 16, 1954. Deliveries by the end of May, 1958, totalled 20 pre-production and 99 production aircraft for the French Air Force, Army and Navy, and 32 aircraft for civil operators.



The Max Holste M.H. 1521 Broussard (450 h.p. Pratt & Whitney R-985 engine).

THE MAX HOLSTE M.H. 1521 BROUSSARD.

Two versions of the Broussard have been built :—

M.H. 1521. Standard production version.

M.H. 1522. Generally similar to M.H. 1521, but with double-slotted wing flaps and full-span leading-edge slots to improve take-off and landing performance. Prototype flew on February 11, 1958.

TYPE.—Six-seat General Utility monoplane.

WINGS.—High-wing rigidly-braced monoplane. NACA 4413 wing section. Aspect ratio 7.5. Chord 1.850 m. (6 ft.) constant. Dihedral 2°. Incidence 3°. All-duralumin structure. Central two-spar box with detachable leading-edge. Metal-covered slotted flaps and ailerons hinged to rear spar. Ailerons arranged to droop 13° when flaps are lowered to 45° while still retaining their differential action. Total area of ailerons 1.09 m.² (11.73 sq. ft.). Total area of flaps 1.60 m.² (17.22 sq. ft.). Each single bracing strut is a steel tube with dural sheet fairing. Gross wing area: 25.2 m.² (271.25 sq. ft.).

FUSELAGE.—Duralumin structure with stressed skin covering.

TAIL UNIT.—Cantilever monoplane type with twin fins and rudders. Duralumin frames with metal-covered fixed surfaces and fabric-covered elevators and rudders. Controllable trim-tabs in both elevators and in port rudder. Areas: fins (2) 1.72 m.² (18.5 sq. ft.), rudders (2) 1.29 m.² (13.88 sq. ft.), tailplane 3.04 m.² (32.72 sq. ft.), elevators 2.02 m.² (21.75 sq. ft.). Tailplane span 4.40 m. (14 ft. 5 in.).

LANDING GEAR.—Fixed tail-wheel type. Spring steel (Cessna licence) main legs. Orientable tail-wheel with self-centering device. ERAM oleo-pneumatic shock-absorbers. ERAM type 10 main wheels. ERAM disc brakes on main wheels. Wheel track 3.08 m. (10 ft. 1 in.). Wheelbase 6.08 m. (19 ft. 11 in.).

POWER PLANT.—One 450 h.p. Pratt & Whitney R-985 nine-cylinder radial air-cooled engine. Hamilton Standard 2.D. 30 constant-speed airscrew. One fuel tank in each wing root, with capacity of 220 litres (48.4 Imp. gallons). Oil capacity 26 litres (5.75 Imp. gallons).

ACCOMMODATION.—Enclosed cabin seating six in three pairs, the front pair with dual controls. Large door in two parts on port side. As an ambulance can carry pilot, two stretcher cases one above other on starboard side and two sitting cases on port side. Agricultural version has spray-gear developed by Fison-Airwork Ltd. Dimensions of cabin: length 3.08 m. (10 ft. 1 in.), width 1.25 m. (4 ft. 1 in.), average height 1.35 m. (4 ft. 5 in.), volume 4.80 m.³ (169.4 cub. ft.).

DIMENSIONS.—
Span 13.75 m. (45 ft. 1 in.).
Length 8.65 m. (28 ft. 4½ in.).
Height 3.67 m. (12 ft. 1 in.).

WEIGHTS AND LOADINGS.—
Weight empty, equipped 1,650 kg. (3,637 lb.).
Weight loaded 2,700 kg. (5,953 lb.).

PERFORMANCE (at 2,500 kg.=5,500 lb. A.U.W.).—
Max. speed at 1,000 m. (3,280 ft.) 259 km.h. (161 m.p.h.).
Cruising speed 228 km.h. (142 m.p.h.).
Stalling speed 92.6 km.h. (57.5 m.p.h.).
Rate of climb at S/L 240 m./min. (785 ft./min.).
Take-off run 200 m. (655 ft.).
Take-off distance to clear 20 m. (65 ft.) 400 m. (1,310 ft.).
Landing distance from 20 m. (65 ft.) 400 m. (1,310 ft.).

THE MAX HOLSTE M.H. 250 SUPER BROUSSARD.

The Super Broussard, the first prototype of which was due to fly in the Autumn of 1958, is a twin-engined transport capable of accommodating 17-22 passengers or 1,870 kg. (4,122 lb.) of freight. It is a high-wing all-metal monoplane with semi-retractable tricycle landing gear and is powered by two 600 h.p. Pratt & Whitney R-1340 Wasp engines or Turbomeca Bastan turboprops. The main wheels retract into fairings built on to the sides of the fuselage.

There will be both military and civil versions of the Super Broussard. The military version will have full-span leading-edge slots and two large doors in the rear fuselage to permit loading of vehicles and/or cargo items up to 7 m. (23 ft.) long.

An initial batch of ten Super Broussards will be built to orders from U.A.T., T.A.I. and Royal Air Maroc.

DIMENSIONS.—
Span 21.85 m. (71 ft. 7 in.).
Length 16.20 m. (53 ft. 2 in.).
Height 6.35 m. (20 ft. 10 in.).
Wing area 54 m.² (581 sq. ft.).

WEIGHTS (designed).—
Weight empty 4,015 kg. (8,850 lb.).
Weight loaded 6,624 kg. (14,603 lb.).

PERFORMANCE (estimated).—
Max. speed 350 km.h. (217 m.p.h.).
Cruising speed at 2,750 m. (9,000 ft.) (55% power) 280 km.h. (174 m.p.h.).
Stalling speed 102 km.h. (63.5 m.p.h.).
Rate of climb at S/L 480 m./min. (1,575 ft./min.).
Ceiling 7,000 m. (23,000 ft.).
Take-off distance to 15 m. (50 ft.) 320 m. (1,050 ft.).
Landing distance from 15 m. (50 ft.) 490 m. (1,610 ft.).
Normal range, with allowances 970 km. (603 miles).
Max. range with allowances 1,970 km. (1,224 miles).



The Max Holste M.H. 1521 Broussard in its civil form.

MORANE-SAULNIER

AEROPLANES MORANE-SAULNIER.

HEAD OFFICE: 3 and 5, RUE VOLTA, PUTEAUX (SEINE).

WORKS: PUTEAUX (SEINE) AND OSSUN-LOUEY, NEAR TARBES (HAUTES-PYRENEES).

Commercial Director: S. Saulnier.

The Morane-Saulnier Company was originally formed in 1911 and its parasol monoplane fighters were flown by the French Air Force and the Royal Flying Corps in the war of 1914-18. In the inter-war period Morane-Saulnier built many notable aircraft, mainly military trainers and single-seat fighters.

Since the war Morane-Saulnier has concentrated mainly on the design and production of trainers. Recent types are the M.S. 733 three-seat basic trainer which has been built in quantity for the French Air Force and Navy, and the M.S. 755 two-seat jet fighter trainer.

From the M.S. 755 has been developed the M.S. 760 which can be used as a two-seat side-by-side trainer or as a four-seat high-speed liaison or communications aircraft. The M.S. 760 Paris has been ordered in quantity by the French Government and is also being supplied to the Argentine Government. The first

production M.S. 760 flew for the first time on February 27, 1958.

Under development are the M.S. 1500 Epervier, a light turboprop-powered two-seat multi-purpose monoplane; and the M.S. 785, a light four-jet transport.

THE MORANE-SAULNIER M.S. 1500 EPERVIER.

The M.S. 1500 is a light two-seat multi-purpose military monoplane which has been designed for cheapness of production and simplicity and economy of operation. It can be armed with a variety of weapons, or can be equipped for observation or light liaison duties.

The first prototype, which flew on May 12, 1958, was powered by a 400 s.h.p. Turbomeca Marcadau turboprop but it has now been re-engined with the 650 s.h.p. Bastan turboprop engine around which the M.S. 1500 was designed.



The Morane-Saulnier M.S.1500 Epervier (Turbomeca Marcadau turboprop engine).

DIMENSIONS.—
Span 12.82 m. (42 ft. 1 in.).
Length 10.16 m. (33 ft. 3 in.).
Height 3.27 m. (10 ft. 10 in.).

Chord 2.168 m. (7 ft. 1 in.) at root, 1.540 m. (5 ft. 1 in.) at tip. Dihedral 8°. Incidence 2°. All-metal structure. All-metal ailerons with static balance and spring tabs. Electrically-operated all-metal split flaps and air brakes, with emergency mechanical operation. Total area of flaps 1.54 m.² (16.57 sq. ft.). Total area of ailerons 2.30 m.² (24.75 sq. ft.). Gross wing area 18 m.² (193.68 sq. ft.).

FUSELAGE. All-metal structure in four sections—nose section, pressurised cabin section, central engine section, and easily detachable tail-section.

TAIL UNIT.—Cantilever T-type tail. All-metal structure. Areas: fin 1.10 m.² (11.83 sq. ft.), rudder 0.53 m.² (5.70 sq. ft.), tailplane 1.57 m.² (16.89 sq. ft.), elevators (total) 1.28 m.² (13.77 sq. ft.). Tailplane span 3.40 m. (11 ft. 2 in.).

LANDING GEAR.—Retractable nose-wheel type. Electrical retraction, with emergency mechanical operation. ERAM oleo-pneumatic shock-absorbers. ERAM wheels and hydraulic brakes. Wheelbase 3.725 m. (12 ft. 2½ in.). Track 2.42 m. (7 ft. 11 in.).

POWER PLANT.—Two Turbomeca Marboré II turbojet engines (400 kg.=880 lb. s.t. each) mounted in the sides of the fuselage with air inlets in the wing roots. Rear fuselage quickly detachable to give access to engines. Main fuel tank (950 litres=210 Imp. gallons) in fuselage. Provision for two auxiliary wing-tip tanks (225 litres=49.5 Imp. gallons each). Oil capacity 20 litres (4.4 Imp. gallons).

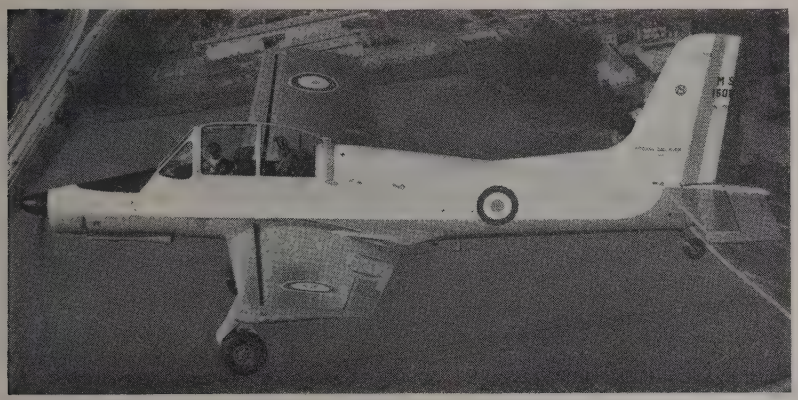
ACCOMMODATION.—Pressurised and air-conditioned cabin seating four in two pairs. Sliding and jettisonable canopy. Rear seats easily removable to convert aircraft to advanced trainer for aerobatics (with tip-tanks removed), blind-flying and night-flying, etc. Can also be adapted for weapon training, deck-landing and ship-board training.

ARMAMENT.—In weapon-training rôle armament can comprise two 7.5 mm. machine-guns in nose of fuselage, ciné gun, racks for two 50 kg. (110 lb.) bombs or four 3.5 in. rockets beneath wings. Gyro gun-sight. In a possible light tactical rôle can be armed with one 30 mm. cannon (60 rounds) in addition to two m.g. twelve rockets, or two 118-kg. (260-lb.) and two 50-kg. (112-lb.), or eight 50-kg. (112-lb.) bombs under wings.

DIMENSIONS.—
Span (over tip tanks) 10.15 m. (33 ft. 3 in.).
Length 10.05 m. (33 ft.).
Height 2.60 m. (8 ft. 6 in.).

WEIGHTS.—
Weight empty (equipped) 1,945 kg. (4,280 lb.).
Weight loaded 3,375 kg. (7,435 lb.).

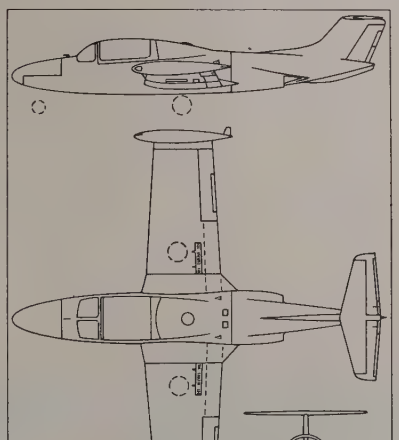
PERFORMANCE (at max. A.U.W.).—
Max. speed 650 km.h. (405 m.p.h.) at S/L.
Max. speed at 7,000 m. (23,000 ft.) 555 km.h. (345 m.p.h.).
Cruising speed 570 km.h. (350 m.p.h.) at 5,000 m. (16,400 ft.).
Landing speed 155 km.h. (96 m.p.h.).
Initial rate of climb at S/L. 690 m./min. (2,264 ft./min.).
Rate of climb on one engine at 1,000 m. (3,300 ft.) 120 m./min. (420 ft./min.).
Rate of climb at 7,000 m. (23,000 ft.) 240 m./min. (780 ft./min.).
Climb to 7,000 m. (22,960 ft.) 18 min.
Service ceiling 10,000 m. (32,800 ft.).
Still-air range at 7,000 m. (22,960 ft.) 1,500 km. (930 miles).
Take-off run 750 m. (820 yds.).



The Morane-Saulnier M.S.1500 Epervier (Turbomeca Marcadau turboprop engine).

WEIGHTS (designed).—
Weight empty (without auxiliary tanks) 1,735 kg. (3,820 lb.).
Weight empty (with auxiliary tanks) 1,775 kg. (3,910 lb.).
Weight loaded (without auxiliary tanks) 2,500 kg. (5,500 lb.).
Weight loaded (with auxiliary tanks) 2,725 kg. (6,000 lb.).

PERFORMANCE (estimated).—
Max. speed at S/L 320 km.h. (199 m.p.h.).
Max. speed at 3,000 m. (9,840 ft.) 330 km.h. (205 m.p.h.).
Rate of climb at S/L 8.5 m./sec. (1,700 ft./min.).
T.O. to clear 15.25 m. (50 ft.) 250 m. (273 yds.).
Landing from 15.25 m. (50 ft.) 240 m. (263 yds.).
Endurance (without auxiliary tanks) 4 hrs. approx. at 3,000 m. (9,840 ft.).
Endurance (with auxiliary tanks) 7.5 hrs. approx. at 3,000 m. (9,840 ft.).



The Morane-Saulnier M.S. 760 Paris.

THE MORANE-SAULNIER M.S. 760 PARIS.

The M.S. 760 was designed primarily as a four-seat high-speed communications aircraft but is also easily adaptable for training and other duties. It is in its communications rôle that the M.S. 760 has been ordered by the French (50) and Argentine Governments (48). The Argentine aircraft will be delivered in component form and assembled at the Government Factory at Cordoba.

The first prototype M.S. 760 flew for the first time on July 29, 1954, the second prototype on March 28, 1957, and the first production aircraft on February 27, 1958.

The M.S. 760 was awarded an American Type Certificate by the C.A.A. in July, 1958. The Beech Aircraft Corporation, of Wichita, Kansas, holds the U.S. sales rights as well as a manufacturing licence for the M.S. 760.

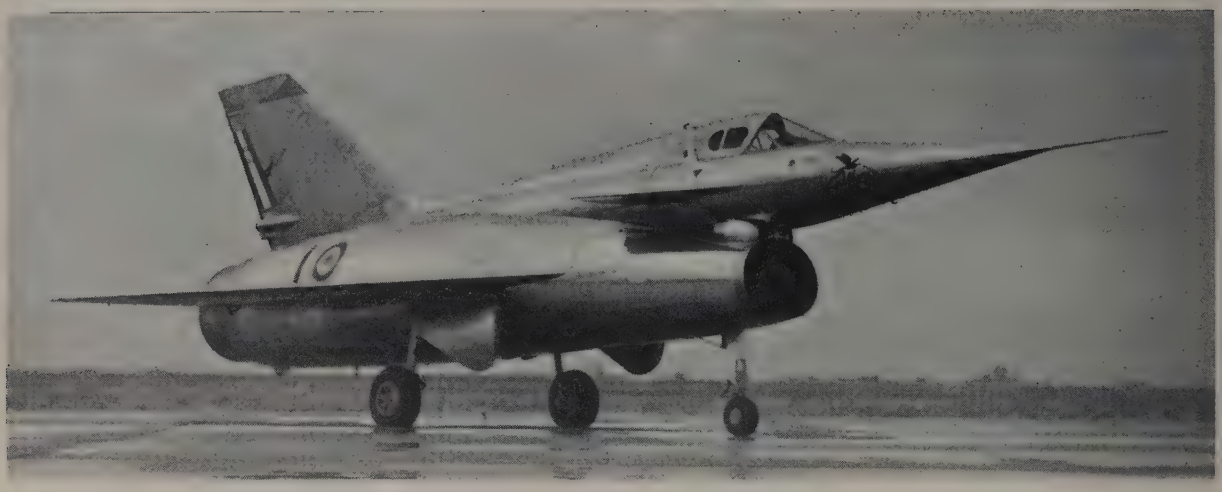
TYPE.—Four-seat high-speed liaison or two-seat training monoplane.

WINGS.—Low mid-wing cantilever monoplane. Wing section NACA 64 A 1 (13.5) at root, (12) at tip. Aspect ratio 5.12



The Morane-Saulnier M.S. 760 Paris (two Turbomeca Marboré turbojets).

NORD



The Nord 1500 Griffon II (SNECMA Atar 101 E3 turbojet in annular Nord ramjet).

NORD-AVIATION, SOCIÉTÉ NATIONALE DE CONSTRUCTIONS AÉRONAUTIQUES.

HEAD OFFICE: 12*bis* AVENUE BOSQUET, PARIS, (7e.)

DEVELOPMENT CENTRE: CHATILLON-SOUS-BAGNEUX (SEINE).

TEST CENTRES: MELUN-VILLAROCHE AND LES GATINES.

WORKS: BOURGES (CHER), LES MUREAUX (SEINE-ET-OISE) AND MEAULTE (SOMME).

Chairman of the Board and President: Paul Mazer.

General Secretary: Jean Otier.

Vice-President, Technical: Noel Daum.

Vice-President, Production: Jean Darteyre.

Technical Managers: MM. Dupin, Stauff and Coroller.

Commercial Director: A. Leconte.

Financial Director: Edouard Lassalle.

Chief Engineers in charge of various departments: MM. Buret, Calvy, Decker, Galtier, Montlaur, Pichon.

This company was formed in 1936 under the laws for the nationalisation of the Aircraft Industry, as the Société Nationale de Constructions Aéronautiques du Nord (S.N.C.A.N.).

Following the liquidation of the S.N.C.A. du Centre in 1949, the Bourges factory of that society was integrated in the Nord group.

Towards the end of 1954, on the recommendation of the Air Secretary of the Ministry of Defence, the Société Francaise d'Etudes et de Constructions de Matériels Aéronautiques Spéciaux (SFECMAS, formerly Arsenal de l'Aéronautique) was amalgamated with the Société Nationale de Constructions Aéronautiques du Nord.

The resulting organisation, which has been known as Nord-Aviation since January, 1958, covers a very wide field of activities in research and development, including the missile and ramjet fields, and has extensive production facilities.

THE NORD 1500 GRIFFON I AND II.

The Nord 1500 Griffon (originally Guépard) experimental aircraft is a potential light interceptor concept, designed to flight-test a new airframe design equipped with a combination turbojet-ramjet propulsion unit. The prototype 1500-01 Griffon I made its first flight on September 20, 1955, powered by an orthodox SNECMA Atar 101F turbojet engine with afterburner. After the completion of the first phase of testing the airframe was modified to take the advanced propulsion unit for which it was designed. In this, a 3,400 kg. (7,500 lb.) s.t. SNECMA Atar 101 E3 turbojet is mounted inside an annular ramjet of Nord design, just forward of the ramjet burners. The ramjet is equipped with fuel pumps able to deliver 40,000 litres/hr. (8,800 Imp. gallons/hr.) and a fuel regulation system consisting of a flow output regulator controlled by an electronic computer, with a limiting device for mixture control according to altitude, speed and throttle position. Although basically the same aircraft, the re-engined model is known as the 1500-02 Griffon II.

The Griffon II flew for the first time on January 23, 1957, and on May 17 it exceeded Mach 1 in level flight with its ramjet ignited, although not using the full power of its combination power-unit. It is claimed that this was the first time that a piloted aircraft propelled by a ramjet had exceeded the speed of sound.

During later flight tests, on December 10, 1957, it reached Mach 1.85 whilst climbing at a rate of about 150 m./sec. (30,000 ft./min.).

The Griffon has 60° delta wings of 4.8% thickness-chord ratio which are fitted with elevons and have a gross area of 32 m.^{2} (344.5 sq. ft.). Low-pressure tyres, flaps and a braking parachute, enable it to operate from all types of airfields. A fixed forward stabiliser, which gives the Griffon a tail-first layout, ensures accurate longitudinal trim at all speeds, including the transonic zone. There are also air-brakes on the fuselage nose-section.

DIMENSIONS.—
Span 8.10 m. (26 ft. 7 in.).
Length 14.54 m. (47 ft. 8½ in.).
Height approx. 5.0 m. (16 ft. 5 in.).

WEIGHT.—
Weight loaded 6,600 kg. (14,550 lb.).

PERFORMANCE (approx.).—
Max. speed above Mach 1.85.
Take-off speed 278 km.h. (173 m.p.h.).
Landing speed 241 km.h. (150 m.p.h.).
Take-off distance 1,000 m. (3,280 ft.).
Landing distance 600 m. (1,970 ft.).

THE NORD 1405 GERFAUT II.

The Gerfaut II is a development of the Gerfaut I, which was the first high-powered jet delta-wing aircraft to fly in France and has been described fully in previous editions of this annual. It



The Nord 1405 Gerfaut II (SNECMA Atar 101G turbojet engine with afterburner).

made its first flight on April 17, 1956, and is powered by a SNECMA Atar 101G turbojet with afterburner. Although similar to the Gerfaut I in some constructional features, 80% of its components were redesigned. It has flown at supersonic speed on many test flights and is being used to test interception radar equipment at high speeds and high altitudes.

On February 16, 1957, the Gerfaut II established a number of climbing speed records. From a standing start it reached 6,000 m. (19,680 ft.) in 1 min. 17 sec., 9,000 m. (29,520 ft.) in 1 min. 34 sec., 12,000 m. (39,360 ft.) in 2 min. 18 sec. and 15,000 m. (49,200 ft.) in 3 min. 46 sec. On February 28, it set up a further record by climbing to 3,000 m. (9,840 ft.) in 51⅛ seconds.

TYPE.—Single-seat Research aircraft.

WINGS.—Mid-set cantilever monoplane of delta planform. Aspect ratio 2.16. Leading-edge sweepback 58° 25′. Thickness-chord ratio 5½%. All-metal structure with two main spars and auxiliary leading-edge and trailing-edge spars. Ailerons and elevators inset in trailing edges. Gross wing area 26.2 m.² (282 sq. ft.).

FUSELAGE.—Circular-section all-metal monocoque structure, with pressurised cockpit built on top as a separate structure. Air brakes on each side of rear fuselage, just forward of jet orifice.

TAIL UNIT.—All-metal cantilever monoplane type, with high-mounted variable-incidence tailplane of delta planform. Large tail blister between fin and fuselage housing a braking parachute. Tailplane area 2m.² (21.53 sq. ft.).

LANDING GEAR.—Retractable tricycle type of Messier design. Main wheels retract inward into wings. Nose wheel turns through 90° when retracted rearward, to lie flush in fuselage beneath the air inlet duct. Tyre pressure 6.5 kg./cm.² (92.5 lb./sq. in.).

POWER PLANT.—One SNECMA Atar 101G turbojet with Nord afterburner, developing 4,400 kg. (9,700 lb.) s.t. for take-off. Total fuel capacity 1,400 litres. (308 Imp. gallons).

ACCOMMODATION.—Pilot in pressurised cabin built above fuselage as separate superstructure. Knife-edge windscreen. Rearward-hingeing canopy.

DIMENSIONS.—
Span 6.68 m. (21 ft. 11 in.).
Length 10.0 m. (32 ft. 9½ in.).

WEIGHT.—
Weight loaded 5,250 kg. (11,575 lb.).

PERFORMANCE.—
Max. speed at 12,000 m. (39,370 ft.) Mach 1.3.
Rate of climb at S/L 13,200 m./min. (43,300 ft./min.).
Service ceiling 16,000 m. (52,500 ft.).
Take-off speed 278 km./h. (173 m.p.h.).
Landing speed 232 km./h. (144 m.p.h.).
Take-off distance 400 m. (1,310 ft.).
Landing distance 500 m. (1,640 ft.).
Endurance 50 min.

THE NORD 3400.

The Nord 3400 was the winner of a design competition for a new army artillery observation aircraft which was organised by the French Air Ministry in February, 1957. Work on the prototype was started in the following month and it flew for the first time on January 20, 1958.



The Nord 3400 (240 h.p. Potez 4-D 30 engine).

Features of the design include the use of split flaps under the ailerons and inboard slotted camber-changing flaps for good take-off and landing performance; a simple method of wing-folding that enables this operation to be carried out by the two crew-members; unusually good all-round view, particularly for the observer whose seat swivels through 360° and whose cabin side-windows are bulged to permit a completely-vertical downward view; and a roomy cabin with large doors that enable the aircraft to be used for casualty-evacuation duties.

TYPE.—Two-seat Observation and Casualty-evacuation monoplane.

WINGS.—High-wing braced monoplane. NACA 23015 wing section. Aspect ratio 8.2. Dihedral 0° 30′. Incidence 4° at root, 3° 30′ at tip. All-metal single-spar structure, fabric-covered except for leading-edge and fuel compartments which are metal-covered. Full-span trailing-edge flaps, consisting of split flaps under ailerons and slotted camber-changing flaps between ailerons and fuselage. Single streamlined bracing strut each side. Manual wing-folding. Gross wing area 19.5 m.³ (209.9 sq. ft.).

FUSELAGE.—Welded chrome-molybdenum steel-tube structure. Forward portion metal-covered. Rear fuselage fabric-covered over wooden stringers.

TAIL UNIT.—Braced monoplane type. Single streamlined bracing strut under tailplane each side.

LANDING GEAR.—Non-retractable tail-wheel type. Cantilever main units, with oleo-shock-absorbers within fuselage.

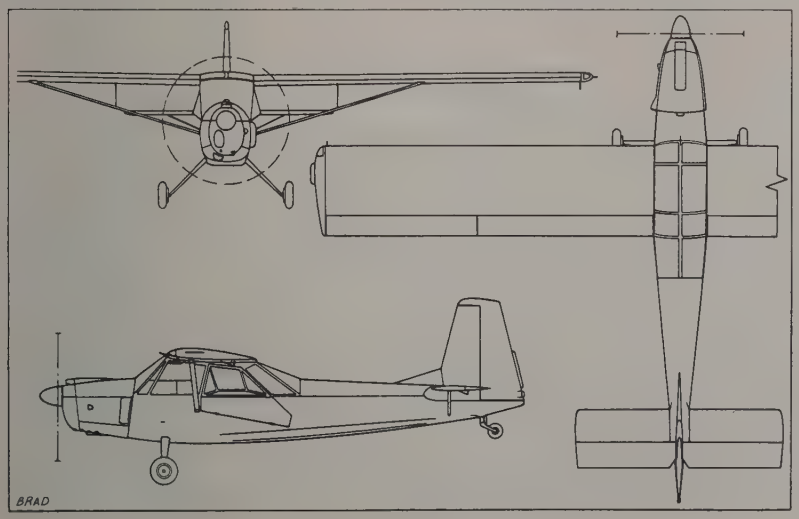
POWER PLANT.—One 240 h.p. Potez 4-D 30 four-cylinder in-line inverted air-cooled supercharged engine, driving Ratier Type 23-92 two-blade adjustable-pitch airscrew. Fuel in two self-sealing rubber tanks with total capacity of 220 litres (48.4 Imp. gallons).

ACCOMMODATION.—Enclosed cabin seating pilot and observer in tandem. Observer's seat, which swivels through 360°, can be removed to make room for a stretcher when aircraft is used for casualty-evacuation. Width of cabin 0.87 m. (34.25 in.). Equipment includes automatic pilot, night-flying equipment, and radio, with provision for reconnaissance cameras and light bomb racks.

DIMENSIONS.—
Span 12.7 m. (41 ft. 8 in.).
Length 8.42 m. (27 ft. 8 in.).
Height 3.10 m. (10 ft. 2 in.).

WEIGHTS.—
Weight empty equipped 920 kg. (2,028 lb.).
Fuel 160 kg. (353 lb.).
Crew 180 kg. (397 lb.).
Operational equipment 90 kg. (198 lb.).
Weight loaded 1,350 kg. (2,976 lb.).

PERFORMANCE.—
Cruising speed 200 km.h. (124 m.p.h.).
Min. speed under 70 km.h. (43.5 m.p.h.).
Rate of climb at S/L 420 m./min. (1,375 ft./min.).
Take-off distance under 100 m. (328 ft.).
Landing distance under 100 m. (328 ft.).
Range 1,000 km. (620 miles).



The Nord 3400 Observation/Liaison Monoplane.

THE NORD 3202.

The 3202, developed from the 3200 and 3201, has been officially adopted as a replacement for the Stampe SV-4 in civilian and military training centres and is now in production. The prototype first flew on April 17, 1957.

TYPE.—Two-seat Trainer.

WINGS.—Low-wing cantilever monoplane. Dihedral 3° 30′. One-piece metal monospar structure covered with fabric. Trailing-edge flaps inboard of ailerons. Gross wing area 16.50 m.² (177.5 sq. ft.).

FUSELAGE.—Welded steel tube structure covered with metal panels forward and fabric aft.

TAIL UNIT.—Cantilever monoplane type. Metal frames covered with fabric. Tailplane incidence adjustable in flight, fin adjustable on ground only. Automatic tabs in elevator and rudder.

LANDING GEAR.—Fixed type. Cantilever oleo-pneumatic shock-absorber legs. Wheel brakes. Steerable tail-wheel.

POWER PLANT.—One 240 h.p. Potez 4.D-32 four-cylinder in-line inverted air-cooled engine with compressor.

ACCOMMODATION.—Tandem seats, with instructor in rear cockpit, under two-piece sliding canopy. Seats are adjustable for height and take back-type parachutes. Full electrical and VHF radio equipment.

DIMENSIONS.—
Span 9.80 m. (32 ft. 1½ in.).
Length 7.99 m. (26 ft. 2½ in.).
Height 3.120 m. (10 ft. 2¾ in.).

WEIGHTS.—
Weight empty 824 kg. (1,813 lb.).
Crew (2) 166 kg. (365 lb.).
Fuel and oil 144 kg. (317 lb.).
Weight loaded 1,134 kg. (2,495 lb.).

PERFORMANCE.—
Max. speed at S/L 260 km.h. (161 m.p.h.).
Min. speed 83 km.h. (51.5 m.p.h.).
Range 1,000 km. (620 miles).

THE NORD 2501 NORATLAS.

The Nord 2501, which was designed as a military transport for the French Air Force, is also being offered as a civil aircraft suitable for the mixed transport of passengers, bulky freight, vehicles, etc. In the civil version the hold or cabin may be arranged to seat 45 passengers. The cabin is fully sound-proofed, ventilated and heated, while toilet and baggage stowage are provided aft.

A contract for 228 2501 Noratlas military transports is being fulfilled for the French Government. In addition several orders for the civil version have been received.



The Nord 2501 Noratlas Transport (two 2040 h.p. SNECMA Hercules engines) in the colours of the German Air Force.

Under a licence agreement signed in June, 1956, the 2501 Noratlas is being built in Germany by the Nordflug company for the German Air Force. The first 25 aircraft were supplied by SNCAN, the remainder (112) being produced by Nordflug. The first German-built Noratlas made its maiden flight on August 6, 1958.

The following developments of the basic 2501 Noratlas have been mentioned :

Nord 2502. Standard 2501 with two wing-tip mounted Turbomeca Marboré turbojet engines to provide additional power for take-off and in an emergency. Nine in service with Union Aéromaritime de Transports (U.A.T.). Others operated by Air Algérie.

Nord 2504. Five for French Navy equipped as flying class-rooms for anti-submarine warfare training.

Nord 2506. Development of 2501 with wing-tip mounted Turbomeca Marboré turbojets, slotted flaps, air-brakes, low-pressure tyres and landing gear shock-absorbers which are "deflatable" on ground to facilitate loading. Hydraulically-operated loading doors can be opened and ramp lowered from cockpit while aircraft is taxiing or stationary. Prototype made its first flight in Summer of 1957. Production order cancelled under 1957 cut-back in defence contracts.

Nord 2507. Evolved from 2502 (with wing-tip jets) as a land/sea rescue aircraft. Provision for flight crew of 5. Cabin accommodates 5 look-outs, 1 radar specialist, 1 reserve mechanic and rest facilities for 6 crew members. Sufficient fuel for endurance of 12 hours. Under development.

Nord 2508. Development of 2501 with two 2,500 h.p. Pratt & Whitney R-2800 CB-17 engines, in place of standard SNECMA Hercules units, and with wingtip-mounted Turbomeca Marboré turbojets to provide additional power for take-off and in emergency. Two-speed superchargers of R-2800 engines permit operation with heavy loads from high-altitude airfields.

The specification which follows refers to the standard 2501 military or civil cargo transport.

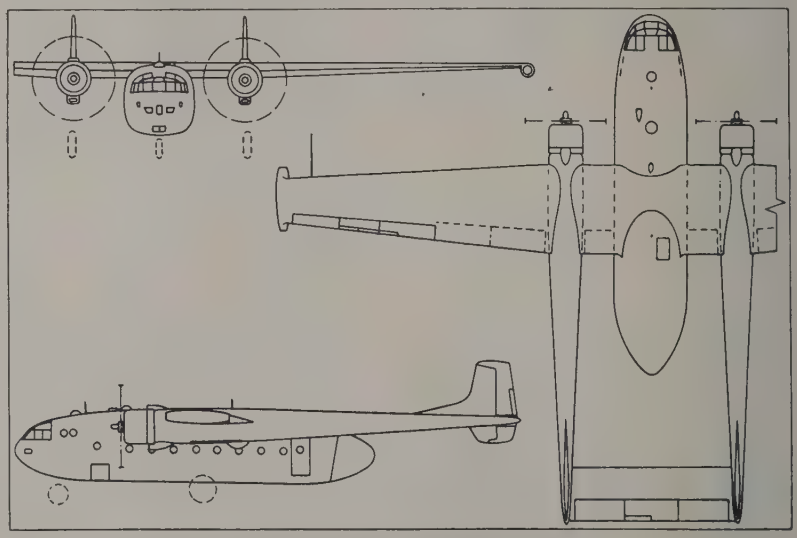
TYPE.—Twin-engined Military and Civil Transport.

WINGS.—High-wing cantilever monoplane. Aspect ratio 10.5. All-metal structure. Wing in three sections, comprising a centre-section which carries the engine nacelles and tail booms at its extremities and supports the central fuselage ; and two outer sections. Ailerons and flaps on outer sections. Wing area 101.2 m.^{2} (1,089 sq. ft.).

FUSELAGE.—The central fuselage, of all-metal construction, accommodates the flight deck and the main hold, Two all-metal booms extending aft from engine nacelles carry the tail-unit. Booms are interchangeable.

TAIL UNIT.—Monoplane type with twin fins and rudders. Fins are integral with tail-booms, tailplane unites the two booms. All-metal structure with metal-covered fixed surfaces and fabric-covered rudders and elevators. Thermal anti-icing for tailplane and fins with single combustion heater on centre-line of tailplane and leading-edge. Later aircraft have extended dorsal fins.

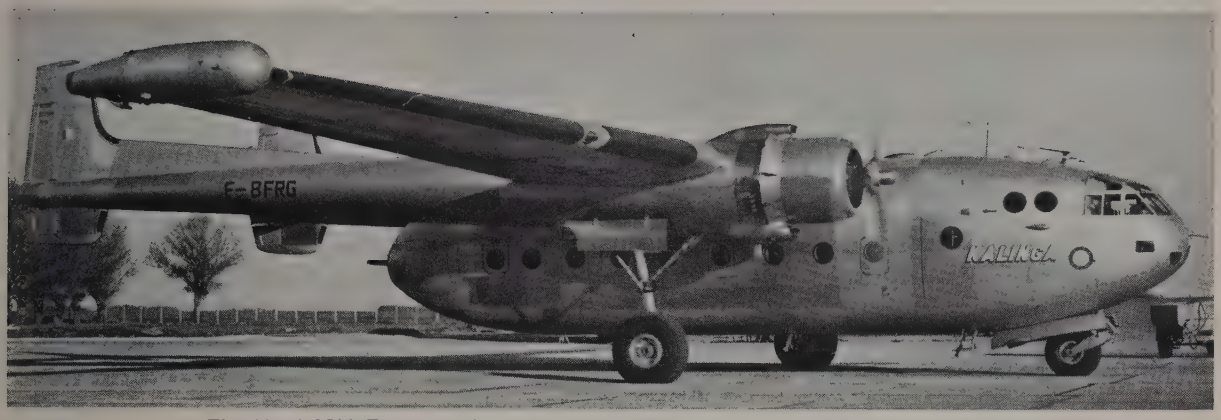
LANDING GEAR.—Retractable tricycle type.



The Nord 2502 Noratlas Transport.



The Nord 2502 Noratlas Transport. This version has two wingtip-mounted Turbomeca Marboré turbojets.



The Nord 2508 Transport (two 2,500 h.p. Pratt & Whitney R-2800 CB-17 engines).

Main landing-gear units are interchangeable port and starboard. Track 7.760 m. (25 ft. 5 in.).

Power Plant.—Two 2,040 h.p. SNECMA (Bristol licence) Hercules 738 or 758 (without torquemeters) or, optionally, 739 or 759 (with torque-meters) fourteen-cylinder radial air-cooled engines in interchangeable nacelles. Four-blade controllable-pitch airscrews, non-reversing with Hercules 738 and 739, reversible with Hercules 758 and 759. Fuel tanks carried in centre-section between spars. Capacity 5,090 litres (1,120 Imp. gallons).

Accommodation.—Flight deck accommodates pilot and co-pilot side-by-side, radio operator and navigator on left and right behind pilots and engineer with folding seat on rear bulkhead. Main hold has reinforced floor and in military version can be arranged to transport freight, wheeled vehicles, troops, paratroops, stretchers, etc. Dimensions of hold : length 9.90 m. (32 ft. 5 in.), max. height 2.75 m. (9 ft.), max. width 2.40 m. (7 ft. 10 in.), volume 51 m.³ (1,800 cub. ft.). Rear end of fuselage is split vertically and hinged to open to full cross-section of hold for direct loading. Small door forward of wing on port side for access to crew compartment. Main cabin door at aft end of hold on port side. For loading of heavy cargo through rear loading doors a "Tirfor" 2-ton winch can be attached to any loading ring on the central row, a roller at the hold sill completing the installation.

Dimensions.—
Span 32.50 m. (106 ft. 7 in.).
Length 21.962 m. (72 ft.).
Height 6.00 m. (19 ft. 8 in.).

Weights and Loadings (Civil version of 2501—Bristol Hercules engines).—
Weight empty equipped 13,075 kg. (28,765 lb.).
Crew 300 kg. (660 lb.).
Disposable load (less crew) 7,925 kg. (17,435 lb.).
Weight loaded 21,000 kg. (46,200 lb.).
Wing loading 207.5 kg./m.² (42.53 lb./sq. ft.).
Power loading 5.14 kg./h.p. (11.30 lb./h.p.).

Weight (2508).—
Weight loaded 23,000 kg. (50,700 lb.).
Landing weight 22,000 kg. (48,500 lb.).

Performance (2501 at 21,000 kg.=46,200 lb. A.U.W.).—
Max. speed 440 km.h. (273 m.p.h.).
Cruising speed at 1,500 m. (4,920 ft.) 324 km.h. (201 m.p.h.).
Cruising speed at 3,000 m. (9,840 ft.) 335 km.h. (208 m.p.h.).
Rate of climb at S/L. 375 m./min. (1,230 ft./min.).
Rate of climb at 3,000 m. (9,840 ft.) 285 m./min. (935 ft./min.).
Rate of climb on one engine at 1,500 m. (4,920 ft.) 60 m./min. (200 ft./min.).
Service ceiling 7,500 m. (24,600 ft.).
Service ceiling on one engine 2,300 m. (7,545 ft.).
Take-off run 660 m. (720 yds.).
Take-off distance to clear 15 m. (50 ft.) 820 m. (893 yds.).
Landing distance from 15 m. (50 ft.) 790 m. (863 yds.).
Landing run with reversing airscrews 420 m. (459 yds.).

Performance (2508 at 22,000 kg.=48,500 lb. A.U.W.).—
Max. cruising speed (2×1,700 h.p.) at 3,050 m. (10,000 ft.) 420 km.h. (260 m.p.h.).
Economical cruising speed (2×950 h.p.) 320 km.h. (199 m.p.h.).
Rate of climb at S/L (all four engines) 600 m./min. (1,960 ft./min.).
Rate of climb at S/L (one piston engine out) 190 m./min. (620 ft./min.).
Service ceiling 9,180 m. (28,000 ft.).
Take-off distance 630 m. (2,060 ft.).
Take-off distance to 15 m. (50 ft.) (one piston engine out) 1,080 m. (3,545 ft.).
Landing distance from 15 m. (50 ft.) 880 m. (2,885 ft.).
Range with 4,300 kg. (9,480 lb.) payload 2,600 km. (1,615 miles).
Range with 6,050 kg. (13,335 lb.) payload 1,220 km. (760 miles).

THE NORD CT.10.

The CT.10 is a remotely-controlled pilotless target aircraft which is powered by an Arsenal pulse-jet developing a thrust of 180 kg. (396 lb.). It is now being used by both the French and British Navies and in Sweden.

The body is in three sections, a nose section of mild steel housing the automatic pilot and controlling gear ; the centre-section, also of mild steel, supporting the cantilever mid-wing surfaces and housing the fuel tanks ; and a tail section of light alloy carrying the twin-finned monoplane tail-unit. The pulse-jet power-unit is supported above the rear half of the body by faired vertical struts, the front member enclosing the fuel lines to the engine.

The CT.10 is launched from a ramp which may be either land-based or seaborne. The launching carriage is propelled by two powder rockets and after separation at approximately 200 ft. the carriage is lowered by parachute.

A radio-controlled auto-pilot permits all normal manoeuvres—turns to right and left, climb, descent. The signal for stopping the engine is also given by radio, the landing and recovery procedure being as follows :—after the engine has stopped and speed has been reduced sufficiently, a parachute is released and the remaining fuel is jettisoned through a dump-valve. In the event of a water landing the target floats until recovered. In a descent on land the steel needle nose section digs into the ground.

The Nord CT.10 is successfully used for both anti-aircraft and anti-missile gunnery training. It is also employed for testing instrumentation, etc. for all kinds of air interception operations.

Dimensions.—
Span 4.300 m. (14 ft. 1¼ in.).
Length 6.014 m. (19 ft. 8 in.).
Height 1.092 m. (3 ft. 7 in.).

Weights.—
Weight loaded 660 kg. (1,452 lb.).

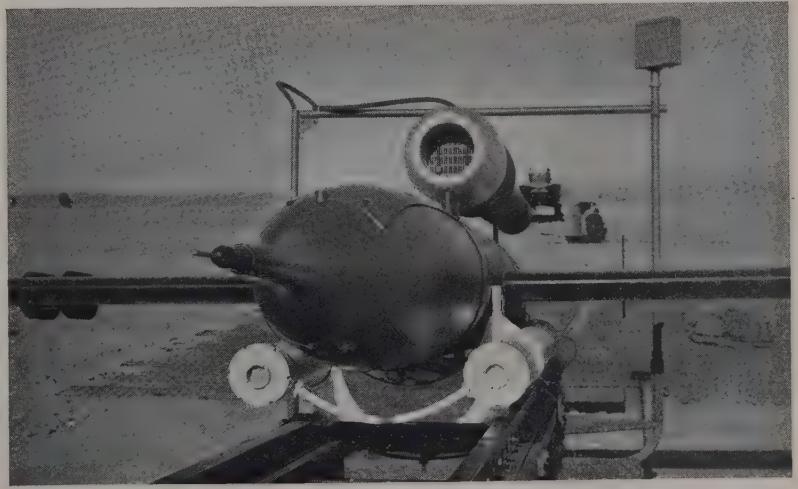
Performance.—
Speed at 4,000 m. (13,120 ft.) 460 km.h. (286 m.p.h.).
Climb to 4,000 m. (13,120 ft.) 10 min.
Range 320 km. (200 miles).

THE NORD CT.20.

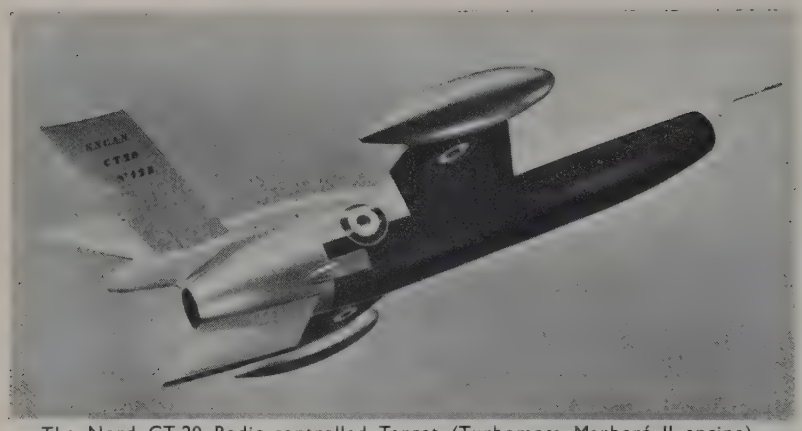
The CT.20 is a turbojet-powered radio-controlled target with a performance comparable with that of modern service aircraft. It is in series production.

The CT.20's launching and control systems are generally similar to those of the CT.10 previously described, although, naturally, engine starting is different. The target is launched from a short mobile ramp 10 m. (32 ft. 9½ in.) long and inclined at an angle of 5 degrees to the horizontal. The launching carriage is powered by two powder rockets and aided by the power of the turbojet engine the CT. 20 has reached a speed of 610 km.h. (555.9 ft./sec.) by the time it has reached its maximum acceleration. The drone then continues to fly under the control of the radio-operator located on the ground or in a "mother" aircraft.

Nine signals can be transmitted, turns to right and left, nose up and down, full



The Nord CT.10 Pilotless Target on its launching ramp.



The Nord CT.20 Radio-controlled Target (Turbomeca Marboré II engine).

throttle, cruising, trace smoke, operate cameras and land. The turning signal controls bank and the turns are executed without any reverse yaw. The pitch signals act directly on the elevators. When the landing signal is transmitted, the engine is stopped and the brake parachute opens and, at the end of a delay period, the recovery parachute is released. The descent is made in a level attitude and the impact with the ground is cushioned by two air-bags placed fore and aft of the centre-section. In the case of radio-control failure the landing sequence occurs automatically.

TYPE. — Turbojet-powered radio-controlled Drone.

WINGS.—Mid-wing monoplane with medium sweepback. Two half wings have two steel-tube spars and aluminium-alloy ribs and covering. Lateral control spoilers at wing tips. Gross wing area 3.2 m.² (33.34 sq. ft.).

FUSELAGE.—In three main sections. Forward section, of aluminium alloy, contains command-guidance, auto-pilot, batteries and principal recovery parachute. Central section composed of a structural steel tank divided into two parts, one for turbofuel and the other containing chemicals for the tracking smoke. Rear fuselage, of aluminium-alloy, contains the engine and carries the tail-unit. A braking parachute is housed in the cone above the jet nozzle.

TAIL UNIT.—Butterfly type. Of aluminium-alloy construction. Comprises two elevator surfaces simultaneously controlled by a single jack.

POWER PLANT.—One Turbomeca Marboré II turbojet engine (400 kg.=880 lb. s.t.).

DIMENSIONS.—
Span 3.4 m. (11 ft. 2 in.).
Length 5.4 m. (17 ft. 8 in.).

WEIGHT.—
T.O. weight 655 kg. (1,444 lb.).

PERFORMANCE.—
Speed at 10,000 m. (32,800 ft.) 900 km.h. (560 m.p.h.).
Time to 10,000 m. (32,800 ft.) 5 min.
Service ceiling 12,000 m. (39,370 ft.).
T.O. acceleration 10 g.
Mean endurance 55 min.

NORMANDE



The Normande Jodel D.117 Grand Tourisme.

SOCIÉTÉ AÉRONAUTIQUE NORMANDE.

HEAD OFFICE AND WORKS: AÉRODROME DE SAINT-MARTIN BERNAY, (EURE).

Director: Lucien Querey.

This company is responsible for production of the Jodel D.117 light aircraft, and has completed the prototype of a new 4/5-seat aircraft of the same basic design known as the D.140. Description of both types are given hereafter.

THE NORMANDE JODEL D.140 MOUSQUETAIRE.

Based on the standard two-seat Jodel design, the new D.140 has been developed by the Normande company as an economical 4/5-seat light aeroplane for touring or club use. The prototype flew for the first time on July 4, 1958, and an initial production series of 100 is being built.

Wing area has been increased to 18 m.² (194 sq. ft.) in the D.140, which is powered by a 180 h.p. Lycoming O-360 four-cylinder horizontally-opposed air-cooled engine. Its normal accommodation is for four persons and 40 kg. (88 lb.) of baggage, but it will carry five persons for short distances. The airframe has a safety factor of 10, and the aircraft is fully aerobatic as a two-seater.

PERFORMANCE (estimated).—
Max. speed 250 km.h. (155 m.p.h.).
Cruising speed (70% power) 225 km.h. (140 m.p.h.).
Landing speed 60 km.h. (37 m.p.h.).
Normal range (four persons) 1,300 km. (800 miles).

THE NORMANDE JODEL D.117 GRAND TOURISME.

TYPE.—Two-seat Light monoplane.

WINGS.—Low-wing cantilever monoplane. Single-spar one-piece wing with wide-span centre-section of constant chord and thickness, and two tapering outer portions set at a coarse dihedral angle. Wood structure, fabric covered. No flaps. Gross wing area 12.7 m.² (136.7 sq. ft.).

FUSELAGE.—Wood structure, fabric covered.

TAIL UNIT.—Cantilever monoplane type. No fin, but rudder faired into top of fuselage. Wood structure, fabric covered.

LANDING GEAR.—Fixed divided type. Cantilever legs with rubber-in-compression springing. Scott hydraulic brakes. Dunlop 400 × 100 main wheels. Scott 6 × 2 steerable tail-wheel. Wheel spats.

POWER PLANT.—One 95 h.p. Continental C90-14F four-cylinder horizontally-opposed air-cooled engine driving Merville or Légère two-blade airscrew, with spinner. Fuel in two tanks, each with capacity of 58 litres (12.75 Imp. gallons). Oil capacity 4 litres (0.88 Imp. gallons).

ACCOMMODATION.—Two seats side-by-side in enclosed cabin, with tinted Plexiglas canopy. Sound-proofing. Provision for radio.

DIMENSIONS.—
Span 8.22 m. (27 ft. 0 in.).
Length 6.50 m. (21 ft. 4 in.).
Height 2.07 m. (6 ft. 9½ in.).

WEIGHT.—
Weight empty 345 kg. (760 lb.).
Weight loaded 600 kg. (1,323 lb.).

PERFORMANCE.—
Max. speed 207 km.h. (129 m.p.h.).
Cruising speed 195 km.h. (121 m.p.h.).
Stalling speed 50 km.h. (31 m.p.h.).
Rate of climb at S/L 240 m./min. (790 ft./min.).
Ceiling 5,000 m. (16,400 ft.).
Take-off run 120 m. (395 ft.).
Landing run 130 m. (425 ft.).
Max. range at 1,500 m. (5,000 ft.) in still air with 20 min. reserve 1,170 km. (725 miles).

PAYEN

PAYEN-AVIATION DELTA.

HEAD OFFICE AND WORKS: 13, QUAI DE L'INDUSTRIE, JUVISY (SEINE-ET-OISE).

Engineer Payen has been engaged in research and development of the delta-wing for the past twenty-five years. He built two delta-wing aircraft before the war, one a light aircraft which flew satisfactorily, and the other a fighter type aircraft which was destroyed during the war.

In 1951 M. Payen began the construction of the Pa.49, an experimental single-seat jet propelled tail-less flying-wing. This aircraft, which was powered by a Turbomeca Palas turbojet (150 kg.= 330 lb. s.t.), made its first flight on January 22, 1954.

After satisfactorily completing its preliminary trials at Melun-Villaroche, the Pa.49 was sent to the Centre d'Essais en Vol, Brétigny, where it completed its first series of tests. It was then fitted with a new Flèchair air-brake system. This takes the form of a split rudder which is effective as a brake throughout the rudder range. The Pa.49 has been described and illustrated in previous editions.

THE PAYEN Pa.60 ARBALÈTE.

Payen-Aviation Delta is now developing the Pa.60 Arbalète, a two-seat aircraft with a "double-delta" wing, two wing-mounted fins and rudders, the extensions of which below the wing house the main landing-wheels and in the case of the first prototype, a 105 h.p. Hirth installed in the rear end of the central nacelle or fuselage and driving a pusher propeller. A second prototype will be jet powered.

The figures below relate to the Hirth-engined prototype.

DIMENSIONS.—
Span 6.80 m. (22 ft. 4 in.).
Length 5.10 m. (16 ft. 9 in.).
Wing area 12.0 m.² (129 sq. ft.).

WEIGHTS (designed).—
Weight empty 305 kg. (670 lb.).
Normal loaded weight 555 kg. (1,220 lb.).
Max. T.O. weight 610 kg. (1,340 lb.).

PERFORMANCE (estimated).—
Max. speed 250 km.h. (155 m.p.h.).
Landing speed 65-70 km.h. (40-43 m.p.h.).
Cruising speed 230 km.h. (143 m.p.h.).
Endurance 5 hours.

PIEL

PIEL-AVIATION S.A.

HEAD OFFICE : 70, ALLÉE DE NEMOURS, LIVRY-GARGAN (SEINE-ET-OISE).

WORKS : 284, AVENUE JEAN-JAURÈS, LE DRANCY (SEINE).

Director : R. Soulé.
Chief Engineer : C. Piel.

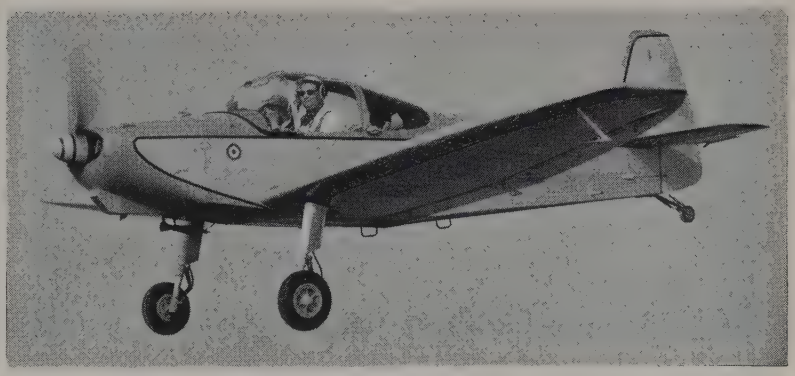
M. Claude Piel has designed and built several light aircraft. His latest is the C.P. 30 Emeraude which is being supplied in completed form and in constructional kits for the amateur builder.

Several other French companies are building the Emeraude under licence. These are :—

Ateliers Aéronautiques De La Côte D'emeraude, Dinard-Pleurtuit aerodrome (I-et-V).

Société De Constructions Aéronautiques Nord (SCANOR), le Plessiel, Abbeville (Somme).

Société Ouest Constructions Aéronautiques (SOCA), les Thillières-en-Vexin (Eure).



The Piel Emeraude (65 h.p. Continental engine). (*Ronald Cole*).

THE PIEL EMERAUDE.

There are two versions of the Emeraude, as follows :—

C.P.30. Basic version with 65 h.p. Continental engine. Prototype flew in 1952 and first production model in 1953.

C.P.301A. Developed version with 90 h.p. Continental engine.

The Emeraude is one of the types approved for amateur construction in the United Kingdom by the Popular Flying Association.

TYPE.—Two-seat light monoplane.

WINGS.—Low-wing cantilever monoplane. NACA 23012 wing section. Aspect ratio 5.95. Chord 1.50 m. (4 ft. 11 in.) at root, 0.55 m. (1 ft. 9½ in.) at tip. Dihedral 5°. Inner half of each wing is rectangular in plan, outer half elliptical. All-wood single-spar structure with fabric covering overall. Slotted ailerons. Gross wing area 10.85 m.² (116.7 sq. ft.).

FUSELAGE.—Rectangular wooden structure with domed deck. Fabric-covered.

TAIL UNIT.—Cantilever monoplane type. Fin integral with fuselage. Single-piece single-spar all-wood tailplane. Elevators and rudder are fabric-covered. Trim-tab in starboard elevator.

LANDING GEAR.—Fixed type. Cantilever legs have rubber-in-compression springing. Hydraulic wheel-brakes. Leaf-spring tail skid. Track 2 m. (6 ft. 6 in.).

POWER PLANT.—One 65 h.p. Continental A65 or 90 h.p. Continental four-cylinder horizontally-opposed air-cooled engine. Holleville two-blade fixed-pitch wood airscrew. Fuel tank in fuselage behind fireproof bulkhead.

ACCOMMODATION.—Enclosed cockpit seating two side-by-side with dual controls. Sides of canopy hinge forward for access and exit. Heating and air-conditioning.

DIMENSIONS.—
Span 8.02 m. (26 ft. 3½ in.).
Length 6.40 m. (20 ft. 11½ in.).

WEIGHTS AND LOADINGS (C.P.30).—
Weight empty 265 kg. (583 lb.).
Weight loaded 500 kg. (1,100 lb.).
Wing loading 46 kg./m.² (9.42 lb./sq. ft.).
Power loading 7.7 kg./h.p. (16.98 lb./h.p.).

WEIGHTS AND LOADINGS (C.P.301A).—
Weight empty 344 kg. (758 lb.).
Weight loaded 610 kg. (1,345 lb.).
Wing loading 56 kg./m.² (11.47 lb./sq. ft.).
Power loading 6.4 kg./h.p. (14.11 lb./h.p.).

PERFORMANCE (C.P.30).—
Max. speed 180 km.h. (112 m.p.h.).
Cruising speed 160 km.h. (100 m.p.h.).
Min. speed 60 km.h. (37.2 m.p.h.).
Rate of climb at S/L 210 m./min. (690 ft./min.).
Service ceiling 4,000 m. (13,125 ft.).
Take-off distance to 15 m. (50 ft.) 120 m. (395 ft.).
Range 800 km. (495 miles).

PERFORMANCE (C.P.301A).—
Max. speed 230 km.h. (143 m.p.h.).
Cruising speed 205 km.h. (127 m.p.h.).
Min. speed 70 km.h. (43.5 m.p.h.).
Rate of climb at S/L 230 m./min. (755 ft./min.).
Service ceiling 4,500 m. (14,750 ft.).
Range 1,100 km. (685 miles).

POTEZ

ETABLISSEMENTS HENRY POTEZ.

HEAD OFFICE : 46, AVENUE KLEBER, PARIS (XVIE).

WORKS : ARGENTEUIL (S-ET-O).

The original Potez company was formed during the 1914-18 war and up to the nationalisation of the French aircraft industry in 1936 Potez was one of the largest and most productive of French aircraft manufacturers.

In 1936 the Potez aircraft factories at Méaulte (Somme) and Sartrouville (S-et-O) were incorporated in the Société Nationale de Constructions Aéronautiques du Nord, and that at Berre (Bouches-du-Rhône) in the S.N.C.A. de Sud-Est.

In 1953 the Société Henry Potez signalised its return to aircraft manufacture, after a lapse of seventeen years, with the appearance of the Potez 75 Army ground-support monoplane.

The Type 75 was designed to meet the requirements of the ground forces as an economical observation, ground support and anti-tank weapon. The prototype flew for the first time on June 10, 1953.

After undergoing extensive trials, during which it logged over 500 flying hours, the Potez 75 was ordered into production for the French Army in 1956, but the contract was cancelled under the 1957 cut-back in military production.

An illustrated description of the Potez 75 has appeared in previous editions of this Annual.

It was announced in June, 1958, that Potez had taken over the former Aviation Department of the Fouga company, which had operated as Air-Fouga since 1956, and that the Fouga works will be known in future as Potez Air Fouga.

SIPA

SOCIÉTÉ INDUSTRIELLE POUR L' AÉRONAUTIQUE.

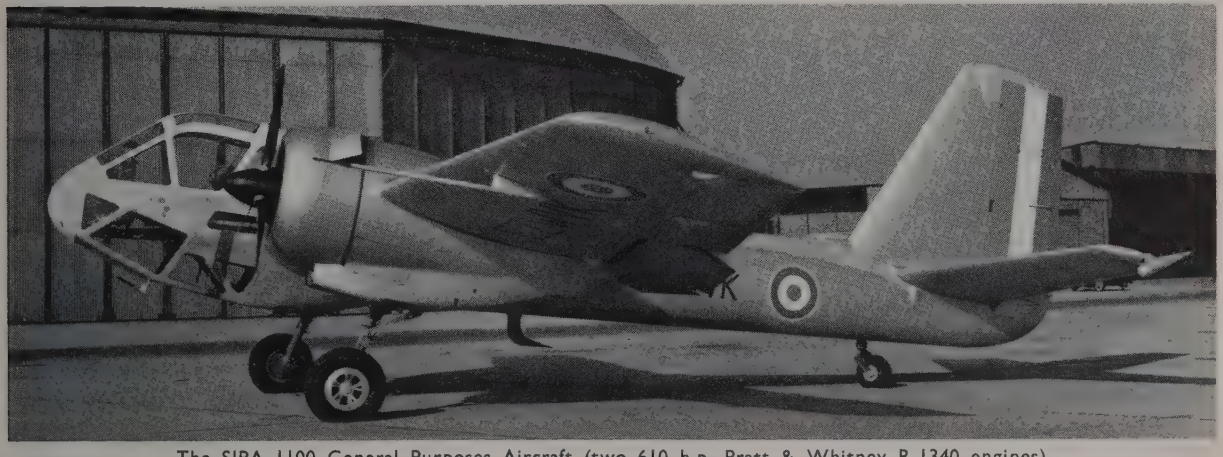
HEAD OFFICE : 178, AVENUE DE NEUILLY, NEUILLY (SEINE).

WORKS : 40, RUE J.-J. ROUSSEAU, SURESNES (SEINE).

President : M. Harrisson.
General Manager : M. Arm.
Technical Manager : M. Gardan.

This Company was formed in 1938. Until 1940 it was engaged in the manufacture of parts and components for Lioré-et-Olivier, Amiot and Morane aircraft and the overhaul of Mureaux aircraft for the French Air Ministry.

Its first post-war production was the S.10, the French version of the Arado Ar 396. This was followed by the S.11 and S.111, which are modified versions fitted with the SNECMA 12S (the French-



The SIPA 1100 General Purposes Aircraft (two 610 h.p. Pratt & Whitney R-1340 engines).

built Argus As 411), and the S.12 which is entirely of metal construction. The company has since produced fifty S.121 trainers, this model differing in only minor details from the S.12. This last-mentioned order brought the total number of aircraft in this series (S.10, S.11, S.111, S.12 and S.121) which have been built for the French Air Force to 234. SIPA was later engaged in converting the earlier S.11's up to S.121 standard.

The SIPA 901 was selected by the Government for use in the schools of the Service de l'Aviation Légère et Sportive and a production order for 100 was completed in 1952.

The latest SIPA product is the 1100, a light twin-engined ground support aircraft for overseas police duties, the prototype of which made its first flight on April 24, 1958. A pre-production order for ten is in hand.

In addition, SIPA is engaged in sub-contract work, including the manufacture of fuselages for the Max Holste Broussard.

THE SIPA 1100.

The SIPA 1100 is a twin-engined general purposes monoplane which is intended for military or police duties in overseas territories. It will be equipped to perform observation, reconnaissance, photographic, ground support and ground attack duties and has been designed to be capable of operating from unprepared airstrips.

Of all-metal construction, the SIPA 1100 is a shoulder-wing monoplane with the crew of three grouped together in a well-glazed compartment forward of the wings. Power is provided by two 610 h.p. Pratt & Whitney R-1340 radial engines. The main landing-gear retracts backward into the engine nacelle fairings. The tailwheel is non-retractable.

Armament consists of two fuselage-mounted 20 mm. cannon while various stores can be carried on underwing racks.

The SIPA 1100 has been designed to an official specification and is the subject of a pre-production order for ten. Further information is restricted.

DIMENSIONS.—
Span 14.70 m. (48 ft. 2½ in.).
Length 11.30 m. (37 ft.).
Height 3.75 m. (12 ft. 3½ in.).

WEIGHTS (designed).—
Weight empty 4,000 kg. (8,800 lb.).
Weight loaded 6,200 kg. (13,640 lb.).

PERFORMANCE (estimated).—
Max. speed at S/L 380 km.h. (227 m.p.h.).
Min. speed 110 km.h. (68 m.p.h.).
Take-off run from grass 600 m. (197 ft.).
Max. range 2,000 km. (1,240 miles).

SNECMA

SOCIÉTÉ NATIONALE D'ETUDE ET DE CONSTRUCTION DE MOTEURS D'AVIATION.

HEAD OFFICE : 150 BOULEVARD HAUSSMANN, PARIS (XIIIe).

WORKS: PARIS (BOULEVARD KELLERMANN), BILLANCOURT (SEINE), MELUN-VILLAROCHE (SEINE-ET-MARNE), SURESNES (SEINE) AND GENNEVILLIERS (SEINE).

President and Director-General : Henri Desbruères.

Administrative Director : M. Depallens.

Technical Director : H. Oestrich.

Director-Controller : Marcel Richer.

Commercial Director : André Esperet.

Director of External Relations : Maurice Roudil.

Director of Atomic Division : Raymond Marchal.

Personnel Manager : M. Dugue MacCarthy.

In addition to its main activities in the design, manufacture and repair of aero-engines, as described in the "Gas-Turbine" and "Piston Engine" sections of this work, SNECMA is engaged on research into methods of vertical take-off for aircraft.

The company has acquired the European rights in Professor von Zborowski's patents for the annular wing, or Coleopter, type of aircraft.

Following extensive development of the "Flying Atar" VTOL research vehicle, SNECMA has combined the principles of this with a Coleopter configuration to produce the C.450-01 experimental VTOL aircraft.

Under an agreement signed in 1958, the Federal German Ministry of Defence is collaborating with SNECMA in this VTOL research programme.

THE SNECMA C.45C-C1 COLÉOPTÈRE.

Following tests of the "Atar Volant," which have proved the ability of a vertically-mounted turbojet to raise a VTOL aircraft safely from the ground, of accelerating it in vertical flight to a speed where it can become airborne like a conventional aircraft, and of returning it to the ground in a vertical descent, SNECMA has built a prototype research aircraft around this type of power plant.

Known as the C.450-01 Coléoptère, this prototype is basically similar to the C.400 P-3 "Atar Volant," with tilting seat inside an enclosed cockpit, but is fitted with an annular wing to permit transition into horizontal flight. The airframe was built by the Nord company in its Chatillon-sous-Bagneux works. It is intended for tests at subsonic speed.

TYPE.—Single-seat Research Coleopter.

WINGS.—Aannular wing of light alloy construction, comprising two skins and internal structure. Chord 3.0 m. (9 ft. 10 in.).

FUSELAGE.—Conventional light alloy structure. Retractable fore-planes on nose.

TAIL UNIT.—Cruciform fins and rudders of light alloy construction, mounted on trailing-edge of wing, to provide directional control in all axes.

LANDING GEAR.—Four oleo-pneumatic legs mounted on trailing-edge of wing. Small castering wheels with rubber tyres.

POWER PLANT.—One SNECMA Atar 101E.V turbojet (3,700 kg. = 8,155 lb. s.t.) mounted aft of cockpit in fuselage. Integral fuel tanks with total capacity of 700 kg. (1,545 lb.) of fuel.

ACCOMMODATION.—Pilot on tilting ejection seat in enclosed cabin.

DIMENSIONS.—
Diameter of wing 3.20 m. (10 ft. 6 in.).
Length overall 8.022 m. (26 ft. 3 in.).

WEIGHT.—
Weight loaded approx. 2,800 kg. (6,175 lb.).

PERFORMANCE.—
No details available.

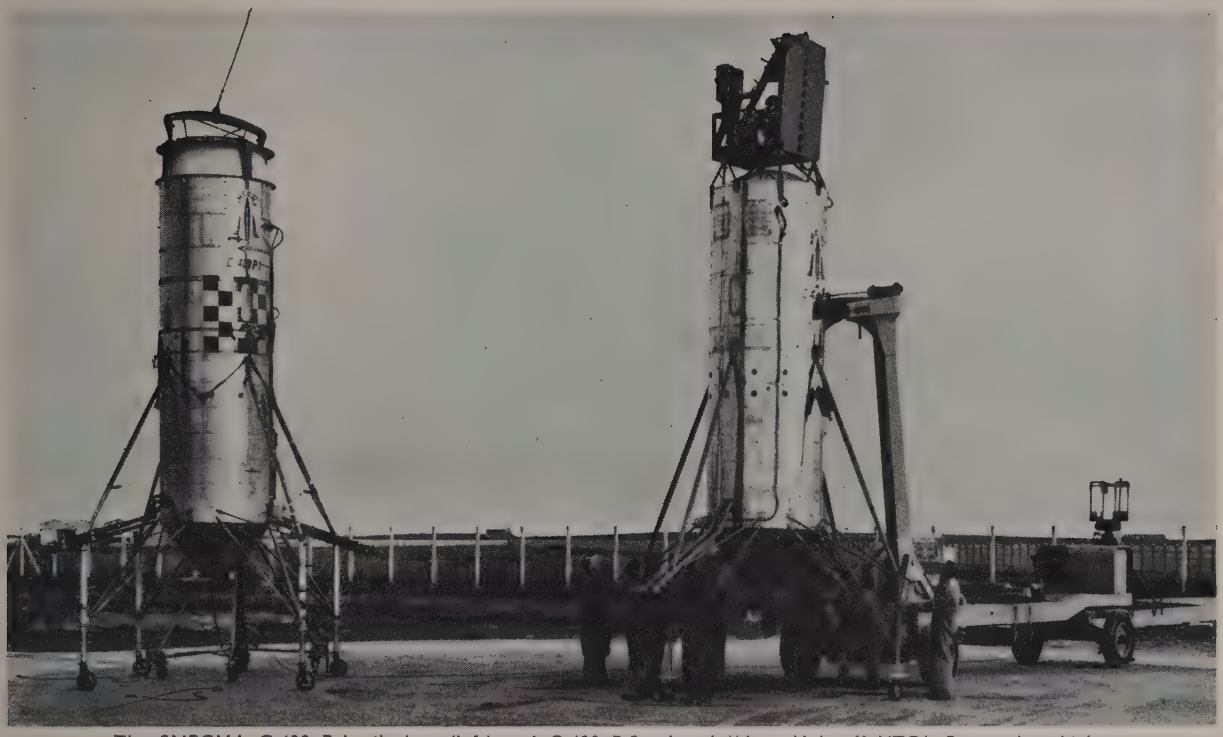
THE SNECMA "ATAR VOLANT."

Following initial research and development work conducted during 1952 and 1953, SNECMA carried out, in 1954, tethered flight tests with a remotely-controlled VTOL model powered by a 45 kg. (100 lb.) s.t. SNECMA pulse-jet engine. These tests were made to investigate control and stability problems, and in the following year vertical rig tests of a full-scale Atar turbojet oil system and gimbal-rig tests of jet-deflection and stabilization devices were made.

The construction of the full-scale Atar Volant was begun in 1955, and



The SNECMA C.45C-C1 Coléoptère.



The SNECMA C.400 P-1 pilotless (left) and C.400 P-2 piloted "Atar Volant" VTOL Research vehicles.

since then four versions have been built, as follows :—

C.400 P-1. Pilotless remotely-controlled research vehicle comprising an Atar 101 DV turbojet (2,900 kg.=6,393 lb. s.t.) with jet-deflection nozzle for directional control, mounted vertically inside a nacelle, on a tubular four-wheel undercarriage. An annular fuel tank was fitted around the centre of the nacelle, with radio control equipment above it, and the vehicle was equipped with gyroscopic control. Tested on gyroscopic rig in 1955. First tethered flight test in specially-built gantry on September 22, 1956. Total of 205 flights made subsequently to study stabilization and the effect of wind.

C.400 P-2. Basically similar to C.400 P-1, but with platform above air intake carrying ejection seat for pilot, instrument panel and controls. Directional control by jet-deviation, using jets of air bled from compressor to deflect main efflux. Lateral turning by air jets on landing gear struts. Annular tanks containing 500 kg. (1,100 lb.) of fuel surround engine compressor, giving endurance of over four minutes. Weight at take-off 2,600 kg. (5,730 lb.). Tethered tests in the gantry began on April 8, 1957. First free flight on May 14, 1957. Total of 123 tethered and free flights made by Spring of 1958.

C.400 P-3. Development of C.400 P-2 built around Atar 101E turbojet (3,500 kg.=7,700 lb. s.t.) and with tilting ejection seat inside enclosed cockpit. As part of the test programme, this version was mounted horizontally on a railway truck with the tail-pipe facing forward and then towed at speeds between 40 and 80 km.h. (25-50 m.p.h.), to test the effect of airflow on the jetstream during a simulated rapid vertical descent.

SUD

SUD-AVIATION, SOCIÉTÉ NATIONALE DE CONSTRUCTIONS AÉRONAUTIQUES.

HEAD OFFICE : 37, BOULEVARD DE MONTMORENCY, PARIS (16e).

WORKS : TOULOUSE, MARIGNANE, COURBEVOIE, SAINT-NAZAIRE, BOUGUENAIS, LA COURNEUVE, ROCHEFORT, MELUN VILLAROCHE, CANNES AND SURESNES.

President-Director General : Georges Hereil.

Director-General : Louis Giusta.

Sud-Aviation was formed on March 1, 1957, by amalgamation of the two companies Ouest-Aviation and Sud-Est Aviation which, until September 1, 1956, had been known respectively as the Société Nationale de Constructions Aéronautiques du Sud-Ouest (S.N.C.A.S.O.) and the Société Nationale de Constructions Aéronautiques du Sud-Est (S.N.C.A.S.E.).

Both of the original companies had been formed in 1936 by the nationalisation of various private companies.

Sud-Aviation employs a total of 22,000 persons and has a covered area exceeding 5,380,000 sq. ft.

Recent and current Sud-Aviation products include the S.E.210 Caravelle medium-range twin-jet airliner, which is in production for Air France and other airlines ; the S.E.212 Durandal supersonic lightweight interceptor ; the S.O. 9050 Trident II supersonic lightweight mixed power interceptor, the S.O.4050 Vautour twin-jet monoplane for tactical support, bombing and all-weather fighting, which is in quantity production for the French Air Force ; and the S.E.3130 Alouette II and S.O.1221 Djinn helicopters, both of which are in major production for the French Army, Air Force and Navy and for civilian customers. The Alouette is also being built under licence by Republic Aviation Corporation in the United States. All of these aircraft are described and illustrated hereafter.

Under development are the S.E.116 Fonceur twin-engined light tactical support aircraft and two new versions of the Alouette known as the Gouverneur and S.E.3140, of which brief details are given below.

In addition, the company is engaged on the study, development and production of missiles and target drones, and is responsible for building the ejector seats for all French jet-powered aircraft.

Besides production of its own designs, Sud-Aviation is building the Aquilon, a French-licence version of the de Havilland Sea Venom, and is participating in the production of the Dassault Mystère series of fighters and the Fouga Magister twin-jet trainer. The company is also engaged on repair and overhaul of the F-84 Thunderjet and Lockheed T-33 for the French Air Force. It is responsible for servicing Vertol H-21 helicopters used in France and is assembling U.S.-built Sikorsky S-58 helicopters.

Sud-Aviation also supervises the work of subsidiaries such as the S.F.E.R.M.A. company, which has added to its former activities the production of aircraft accessories for the Vautour, and the Saint Chamond-Granat company, which includes among its activities the production of special instruments designed for Sud-Aviation products.

Sud Aviation and Fiat have established a joint technical office in Milan to be known as the Bureau Technique Aviation France-Italie (Ufficio Tecnico Aviazione Francia-Italia), the purpose of which will be to study development problems of common interest.

THE S.E.210 CARAVELLE.

The Caravelle is a twin-jet short-to-medium-range airliner which was designed by Sud-Est and was ordered in prototype form by the Secretariat d'Etat a l'Air in January, 1953. The first of two prototypes flew for the first time on May 27, 1955, and the second made its maiden flight on May 6, 1956.

At the time of writing Caravelles had been ordered by Air France (24), SAS (16), VARIG of Brazil (2), Air Algérie (3), Royal Air Maroc (1), and Finnair (3).

Production of the Caravelle is being undertaken by a large group of factories with final assembly being done at Sud-Aviations Toulouse plant. The first production Caravelle, the first for Air France, flew on May 18, 1958.

The following specification applies to the production Caravelle, the first two of which were scheduled for delivery to Air France before the end of 1958.

TYPE.—Twin-jet Medium-Range Airliner.

WINGS.—Low-wing cantilever monoplane. NACA 65,212 wing section with cambered leading-edge. Aspect ratio 8.02. Sweepback 20° at 25% of chord. Dihedral 3°. Incidence at root 2°. Chord 6.33 m. (20 ft. 9 in.) at root, 2.23 m. (7 ft. 4 in.) at tip. Wing in two sections joined on fuselage centre-line. All-metal structure. Two-piece all-metal ailerons on each wing. Slotted trailing-edge flaps. Air brakes on upper and lower surfaces ahead of flaps. Thermal de-icing. Total area of ailerons 7.84 m.² (84.4 sq. ft.). Total area of flaps 24.70 m.² (265.8 sq. ft.). Gross wing area 146.7 m.² (1,579 sq. ft.).

FUSELAGE.—Circular section all-metal monocoque structure. Overall length 32.01 m. (104 ft. 10 in.). Maximum diameter 3.20 m. (10 ft. 6 in.). Length of pressurised section 25.96 m. (85 ft.).

TAIL UNIT.—Cantilever monoplane type. Sweepback of tailplane 30° at 25% of chord. All-metal structure. Thermal de-icing. Areas: fin 10 m.² (107.6 sq. ft.), rudder 5.5 m.² (59.2 sq. ft.), tailplane 21.55 m.² (232 sq. ft.), elevators 6.45 m.² (69.4 sq. ft.). Tailplane span 10.6 m. (34 ft. 9 in.).

LANDING GEAR.—Retractable nose-wheel type. Hispano shock-absorbers. Twin nose-wheel unit with Hispano 503.851 wheels. Each main unit has a four-wheel bogie with Hispano 241.642 wheels. Hydraulic retraction. Maxaret anti-skid brakes on main wheels. Track of main units (between centre-line of shock struts) 5.21 m. (17 ft.). Wheelbase 11.79 m. (38 ft. 7 in.).

POWER PLANT.—Aircraft of the initial series will have two Rolls-Royce Avon RA.29 axial-flow turbojet engines (4,762 kg.= 10,500 lb. s.t. each) mounted in nacelles one on each side of the rear fuselage just ahead of tail unit. Aircraft of the second series (beginning in 1960) will have two Rolls-Royce Avon RA.29 turbojets of 5,217 kg. (11,500 lb.) s.t. each in a similar installation. Integral wing fuel tanks. Total fuel capacity 18,500 litres (4,068 Imp. gallons).

ACCOMMODATION.—Crew compartment in nose for two or three persons. Main cabin with accommodation for 64 first class or 80 tourist passengers. Entire accommodation pressurised to maintain a cabin atmosphere of 2,500 m. (11,480 ft.) to a height of 12,000 m. (39,350 ft.). Main access to cabin aft through door under rear fuselage with hydraulically-operated integral steps. Steps serve as tail support when lowered. Cabin floor 2.10 m. (6 ft. 10 in.) above ground level. Two toilets, coat rooms and light baggage racks aft of cabin. Two galleys, one forward and one aft of cabin. Baggage in three compartments, under front of cabin with 6.0 m.³ (212 cub. ft.) capacity, under rear of cabin with 2.7 m.³ (96 cub. ft.) capacity, and to rear of aft galley with 8.5 m.³ (300 cub. ft.) capacity.

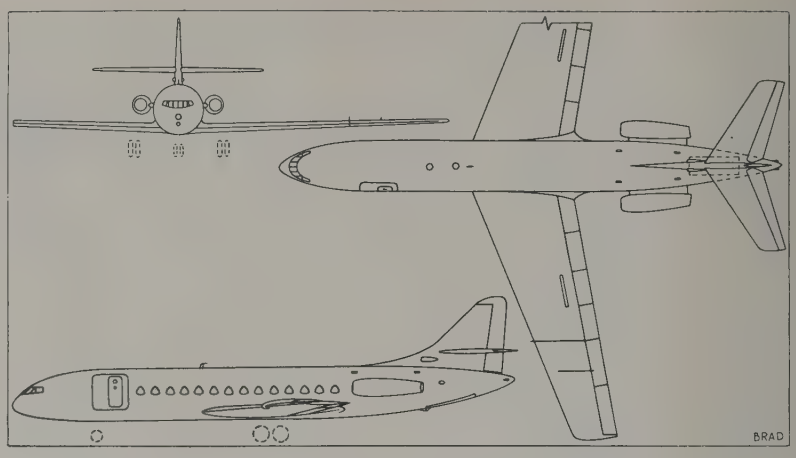
DIMENSIONS.—
Span 34.30 m. (112 ft. 6 in.).
Length 32.01 m. (104 ft. 10 in.).
Height 8.72 m. (28 ft. 7 in.).

WEIGHTS (with 4,762 kg.= 10,500 lb. s.t. engines).—
Weight empty equipped 23,200 kg. (51,000 lb.).
Max. design take-off weight 41,000 kg. (90,400 lb.).
Max. landing weight 39,000 kg. (86,000 lb.).
Max. zero fuel weight 33,000 kg. (72,750 lb.).

WEIGHTS (with 5,217 kg.= 11,500 lb. s.t. engines).—
Weight empty equipped 23,200 kg. (51,000 lb.).
Max. payload 9,000 kg. (19,840 lb.).
Max. design take-off weight 43,000 kg. (94,800 lb.).
Max. landing weight 41,000 kg. (90,400 lb.).
Max. zero fuel weight 33,000 kg. (72,750 lb.).

PERFORMANCE (with 4,762 kg.= 10,500 lb. s.t. engines).—
Cruising speed at 9,300-10,970 m. (30,500-36,000 ft.) 740 km.h. (460 m.p.h.).
Take-off field length at 41,000 kg.= 90,400 lb. A.U.W. at S/L with one engine out 1,680 m. (5,500 ft.).
Landing distance from 15 m. (50 ft.) at 39,000 kg.= 86,000 lb. A.U.W. at S/L. 975 m. (3,200 ft.).

PERFORMANCE (with 5,217 kg.= 11,500 lb. s.t. engines).—
Cruising speed 830 km.h. (515 m.p.h.).
Take-off field length at 43,000 kg.= 94,800 lb. A.U.W. at S/L. with one engine out 1,680 m. (5,500 ft.).
Landing distance from 15 m. (50 ft.) at 41,000 kg.= 90,400 lb. A.U.W. at S/L. 1,000 m. (3,300 ft.).
Range with max. payload, with reserves, 2,400 km. (1,500 miles).



The S.E. 210 Caravelle Medium-Range Airliner.

THE S.E. 212 DURANDAL.

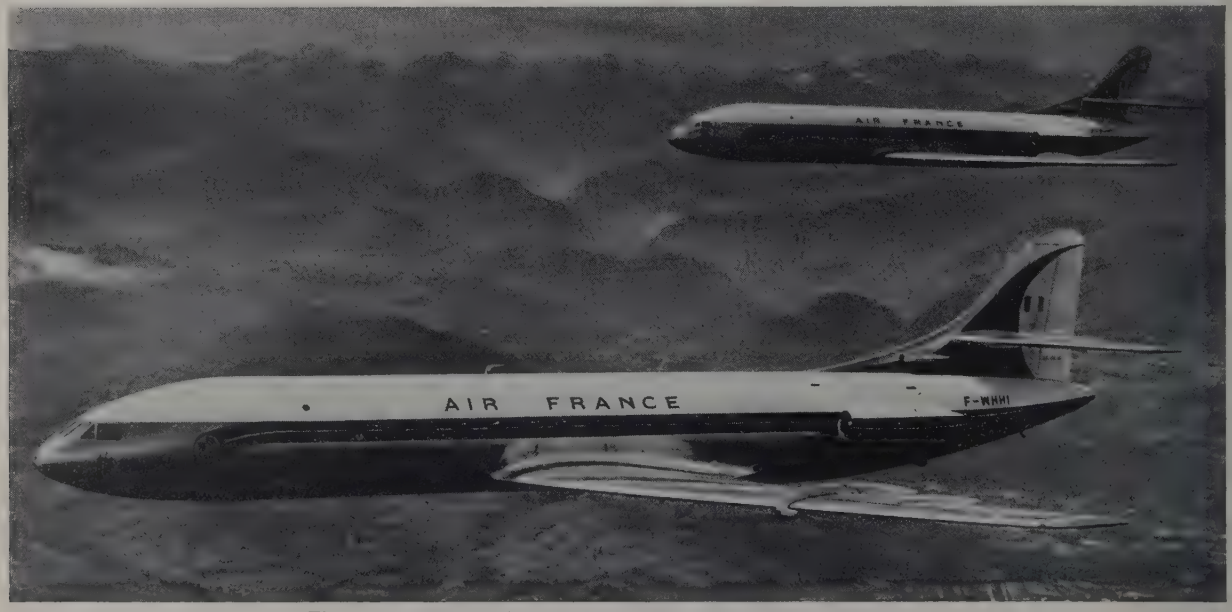
The Durandal is a single-seat delta-wing lightweight interceptor powered by a SNECMA Atar G-3 turbojet, developing 4,500 kg. (9,920 lb.) s.t. with afterburner, and an SEPR 65 liquid-propellent rocket-motor of 825 kg. (1,819 lb.) s.t. The rocket-motor is installed complete with its fuel tanks and pumps in a detachable fairing under the fuselage and is used to boost acceleration to supersonic speeds at high altitude.

Because the rocket pack is easily removable, the propellent tanks can be recharged away from the aircraft, which simplifies handling of the propellents. Alternatively, an external kerosene fuel tank can be fitted in place of the rocket pack, to supplement the internal fuel tankage in the wings and fuselage.

The Durandal has wings of approximately 5% thickness-chord ratio, knife-edge wind-screen, a massive fin and rudder and an unusual under-fairing blade under its nose. The nose-wheel of its landing-gear retracts rearward and the main wheels retract forward, all units being stowed inside the fuselage in flight.

Normal armament comprises a Matra 510 air-to-air guided missile carried under the rocket pack, but provision is made also for conventional armament.

The first prototype flew for the first time on April 20, 1956, powered only by the Atar turbojet with afterburner, and had almost completed its test programme at the time of going to press. It has



The two prototype S.E. 210 Caravelle Medium-Range Airliners.

proved capable of speeds in level flight corresponding to a Mach number of more than 1.5 and has been rolled at Mach numbers above 1.2 with and without its air-to-air missile. It needs a landing and take-off run of approximately 700 m. (2,300 ft.).

A projected developed version, known as the Durandal IV, will have a SNECMA Atar 9 turbojet, giving 6,060 kg. (13,360 lb.) s.t. with afterburner.

DIMENSIONS (approx.).—
Span 6.5 m. (21 ft. 4 in.).
Length 11.0 m. (36 ft. 1 in.).
Height 4.0 m. (13 ft. 1½ in.).
Wing area 22 m.² (236 sq. ft.).

WEIGHTS AND LOADINGS (approx.).—
Weight empty 2,720 kg. (6,000 lb.).
Weight loaded 4,050 kg. (8,930 lb.).
Wing loading 184 kg./m.² (37.7 lb./sq. ft.).
Power loading 0.79 kg./kg. s.t. (0.79 lb./lb. s.t.).

PERFORMANCE.—
Max. speed at 12,000 m. (39,370 ft.) 1,700 km.h. (1,055 m.p.h.).
Rate of climb at S/L 12,000 m./min. (39,370 ft./min.).
Rate of climb at 11,000 m. (36,000 ft.) 8,400 m./min. (27,560 ft./min.).
Service ceiling 17,000 m. (55,775 ft.).

THE S.E. 116 VOLTIGEUR.

Known originally as the Fonceur, the Voltigeur is a twin-engined tactical support aircraft of conventional low-wing monoplane configuration. It has a retractable tricycle landing gear and cantilever monoplane tail unit. A perforated door-type air-brake is hinged on each side of the rear fuselage.

The prototype Voltigeur, which flew for the first time on June 5, 1958, has two 800 h.p. Wright Cyclone radial engines, but production models will have two 650 h.p. Turbomeca Bastan turboprop engines.

DIMENSIONS (approx.).—
Span 18 m. (59 ft.).
Length 12.50 m. (41 ft.).

PERFORMANCE (Bastan engines).—
Cruising speed approx. 450 km.h. (290 m.p.h.).

THE S.E. AQUILON.

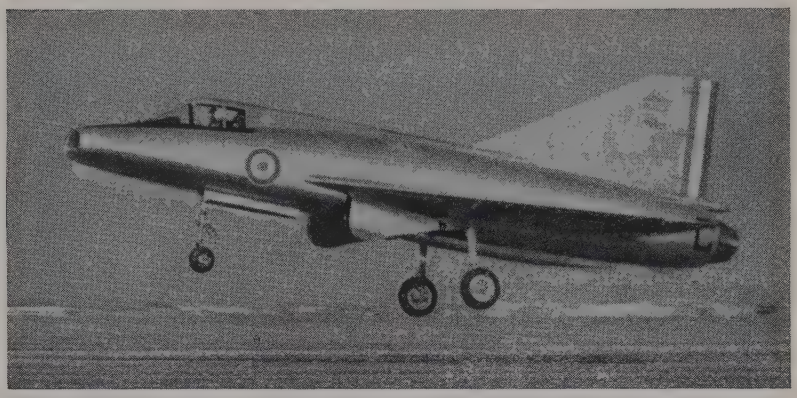
The Aquilon is the French licence version of the de Havilland Sea Venom which is being produced for the French Navy.

The following versions of the Aquilon have been built :—

Aquilon Mk. 20. Prototype similar to Sea Venom Mk. 20. Has 15 ft./sec. (4.57 m./sec.) landing gear, hinged hood-type canopy and fixed seats.

Aquilon Mk. 201. Advanced prototype. One only. This aircraft underwent catapulting and arrester-gear trials at R.A.E., Farnborough in 1954. Similar to Mk. 202 but with 15 ft./sec. (4.57 m./sec.) landing gear.

Aquilon Mk. 202. Initial production version, the first of which flew on March 24, 1954. Has 18 ft./sec. (5.48 m./sec.) landing gear as on Sea Venom Mk. 21, sliding canopy and Sud-Aviation ejector seats.



The S.E. 212 Durandal (SNECMA Atar turbojet engine with afterburner).

Aquilon Mk. 203. Similar to Mk. 202 but is a single-seat version. Is also equipped with more advanced type of radar.

Aquilon Mk. 204. Two-seat unarmed trainer version of the Mk. 203. Has 15 ft./sec. (4.57 m./sec.) landing gear, sliding canopy and ejection seats.

Two production orders for a total of 50 of the Mk. 202 two-seat carrier-borne all-weather fighters were completed by the Spring of 1956, when work started on a further contract for 40 of the Mk. 203 single-seat version.

All versions are powered by a Ghost 48 Mk. 1 turbojet engine (2,200 kg.=4,840 lb. s.t.).

Fixed armament consists of four 20 mm. cannon plus eight rockets. In addition, a Matra 5103 air-to-air missile can be carried under each wing.

DIMENSIONS.—
Span (over tip-tanks) 13.071 m. (42 ft. 10½ in.).
Width folded 7.02 m. (23 ft.).
Length 11.137 m. (36 ft. 6 in.).
Height 2.31 m. (7 ft. 7 in.).
Height (with wings folded) 3.00 m. (9 ft. 10 in.).
Gross wing area 26.0 m.² (280 sq. ft.).

PERFORMANCE.—
Max. speed 960 km.h. (600 m.p.h.).
Service ceiling 15,000 m. (49,200 ft.).

THE S.O. 4050 VAUTOUR.

The S.O. 4050 Vautour is a swept-wing twin jet monoplane which has been designed for tactical support, bombing and all-weather fighting. Reconnaissance and dual-control trainer versions are under development.

The first prototype, which flew on October 16, 1952, exceeded Mach 1 in a slight dive at altitude during its early trials and was the first French twin-jet aircraft to do so.

The original order for three prototypes was followed in 1953 by an order from the French Government for six pre-production Vautours, comprising one bomber, two tactical support aircraft and three all-weather fighters. Various engines were fitted in these first nine aircraft, including several marks of SNECMA Atar, Armstrong Siddeley Sapphires and Rolls-Royce Avons. One of them was used for the first French trials of flight-refuelling jet aircraft in January, 1958, when it was refuelled by a British Canberra tanker.

The Vautour has been ordered into quantity production for the French Air Force in all three versions, each powered by two Atar 101E turbojets of 3,500 kg. (7,700 lb.) s.t. each. Designations of the production aircraft are as follows :—

Vautour A. Single-seat tactical fighter. First production machine of this type flew on April 30, 1956.

Vautour B. Two-seat bomber version.

Vautour N. Two-seat all-weather fighter version.

Initial contracts are for 160 Vautours, comprising 30 of the "A" model, 60 of the "B" and 70 of the "N". Of these, 24 "A", 2 "B" and 27 "N" aircraft had been delivered by the end of January, 1958. Six Vautours are also being supplied to the Israeli Air Force.

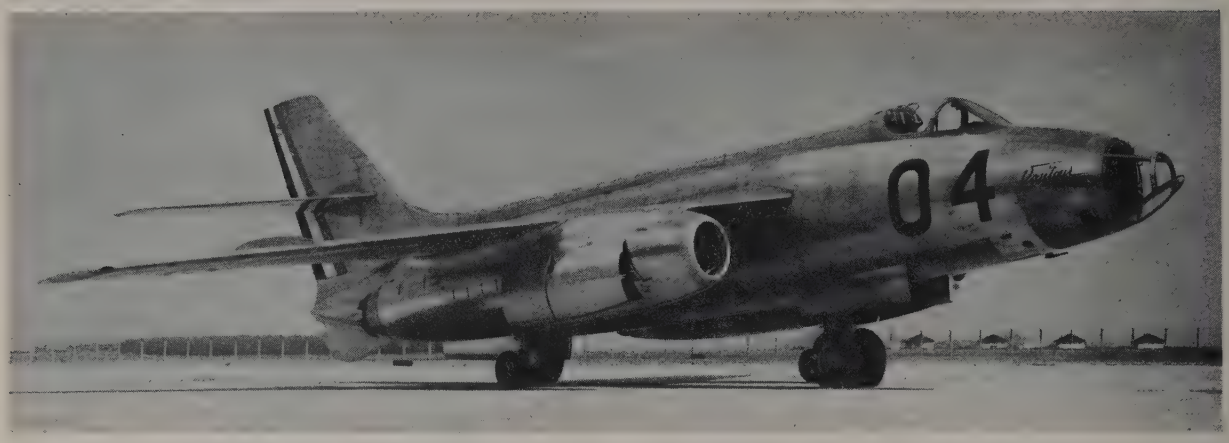
Special gear enables the tactical support and bomber versions to drop their bombs at transonic speeds from all altitudes.

Among the sub-contractors participating in the production of the Vautour are Nord, SFERMA, Dassault, Bréguet, Ratier, SABCA, Chausson and more than 300 suppliers.

The following details apply generally



The S.E. 116 Voltigeur Tactical Support Aircraft (two 800 h.p. Wright Cyclone engines).



The S.O. 4050 Vautour B Two-seat Bomber (two SNECMA Atar 101E turbojet engines).

to all production versions of the Vautour, except where stated otherwise :—

TYPE.—Multi-rôle Military aircraft.

WINGS.—Mid-wing cantilever monoplane with 35° of sweepback. All-metal structure. Vortex generators forward of ailerons.

FUSELAGE.—Oval-section all-metal structure.

TAIL UNIT.—Cantilever monoplane type, with "all-flying" tailplane. All surfaces swept-back. All-metal structure. Small ventral fin under rear fuselage.

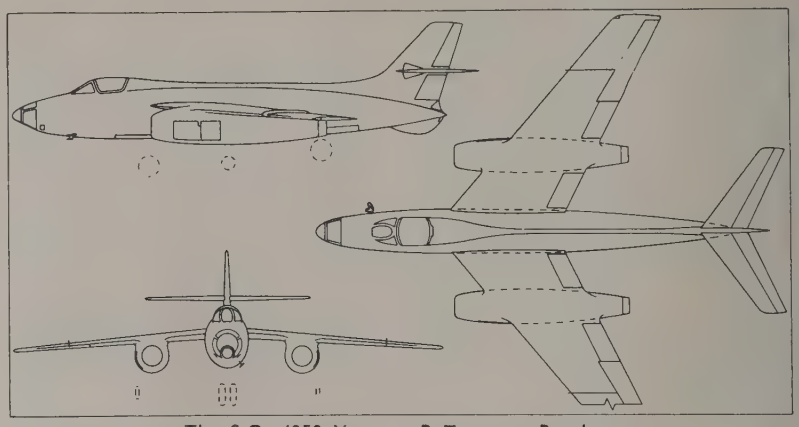
LANDING GEAR.—Retractable tandem type. Two main twin-wheel units in tandem. Front unit retracts forward and rear unit retracts rearward into fuselage fore and aft of bomb-bay. Small outrigger wheel units retract into outboard sides of engine nacelles. Ribbon-type braking parachute.

POWER PLANT.—Two SNECMA Atar 101E-3 axial-flow turbojet engines, each of 3,500 kg. (7,700 lb.) s.t.

ACCOMMODATION.—Tactical support version has single seat. All-weather fighter has two seats in tandem. Bomber has second seat for bomb-aimer in nose. All crew positions are pressurised and provided with Sud-Aviation ejection seats. Irreversible control system incorporates artificial "feel."

ARMAMENT (Tactical support).—Four 30 mm. DEFA guns mounted in the fuselage nose, each with 100 rounds of ammunition. Up to 240 SNEB rockets or ten bombs or a Type B.10 air-to-surface missile in the fuselage bomb-bay. Under-wing pylons for 2×1,250 litre (275 Imp. gallons) drop fuel tanks or four Matra M.116E "honey-comb" packs each containing 19 rockets, or two bombs of up to 450 kg. (1,000 lb.) weight or 24 Type 36 120 mm. rockets.

ARMAMENT (Bomber).—Similar to tactical support aircraft, but without guns. Transparent nose for bomb-aimer.



The S.O. 4050 Vautour B Two-seat Bomber.

ARMAMENT (All-weather Fighter).—Four 30 mm. DEFA guns in fuselage nose, each with 100 rounds of ammunition. Up to 240 SNEB rockets in fuselage bomb-bay. Under-wing pylons for two 1,250 litre (275 Imp. gallons) drop fuel tanks or four Matra M.116E "honey-comb" packs each containing 19 rockets or four Matra 5103 air-to-air missiles. Automatic search and tracking fire-control radar, suitable for use with guns, rockets or guided missiles, developed by the Compagnie Générale de Télégraphie Sans Fil (C.S.F.).

DIMENSIONS.—
Span approx. 15 m. (50 ft.).
Length approx. 15 m. (50 ft.).
Height approx. 4.5 m. (15 ft.).

WEIGHTS.—
Weight empty 10,000 kg. (22,000 lb.).
Weight loaded approx. 15,000-20,000 kg. (33,000-44,000 lb.) according to rôle.

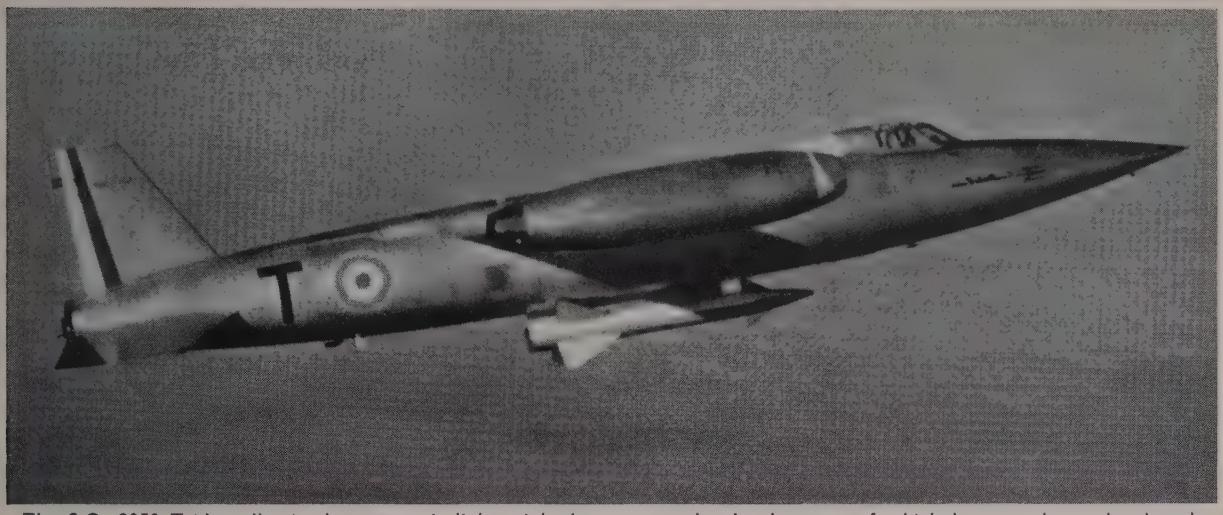
PERFORMANCE.—
Max. speed 1,100 km.h. (680 m.p.h.).
Rate of climb at S/L. 3,600 m./min. (11,800 ft./min.).
Ceiling over 15,000 m. (49,200 ft.).
Take-off run less than 800 m. (2,625 ft.).
Landing run less than 800 m. (2,625 ft.).

THE S.O. 9050 TRIDENT II.

The S.O. 9050 Trident II mixed power unit lightweight interceptor is a direct development of the S.O.9000 Trident I



The S.O. 4050 Vautour N Two-seat All-weather Fighter (two SNECMA Atar 101E turbojet engines).



The S.O. 9050 Trident II mixed power-unit lightweight Interceptor the development of which has now been abandoned.

research aircraft, which was described in earlier editions of "All the World's Aircraft."

The contract for two prototypes of the S.O. 9050 was signed in 1954 and the first of these flew on July 19, 1955, using turbojet power only. The first flight with rocket power was made on December 21, 1955. One of these prototypes was destroyed when its rocket fuels mixed accidentally in the air on May 21, 1957.

An order was placed for six pre-production Tridents and the first of these flew for the first time on May 3, 1957.

One of the pre-production aircraft, with Turbomeca Gabizo turbojet engines, set up an aeroplane height record of 24,300 m. (79,704 ft.) on May 2, 1958. This was the last flight made by a Trident before the entire programme for this aircraft was cancelled as an economy measure.

TYPE.—Single-seat mixed-power Lightweight Interceptor.

WINGS.—Shoulder wing cantilever monoplane of constant chord and section. No spars. Leading-edge, main torsion box and full-span flaps have all-metal bonded "honeycomb" structures. No ailerons. Wing area 14.50 m.² (156 sq. ft.).

FUSELAGE.—Simple all-metal structure of circular section. Air brakes on rear fuselage.

TAIL UNIT.—Cantilever monoplane type, comprising three one-piece all-moving surfaces actuated by Jacottet-Leduc irreversible hydraulic servo-controls. Vertical surface acts as rudder. Lateral surfaces give control in both bank and pitch. (Cockpit controls are conventional).

LANDING GEAR.—Retractable tricycle type, all units of which retract forward into fuselage. Lowered mechanically under combined effect of its own weight and drag and a pneumatic booster. Braking parachutes in rear fuselage.

POWER PLANT.—One SEPR 631 rocket-motor in rear fuselage, with two combustion chambers giving total thrust of 3,000 kg. (6,612 lb.). Two wing-tip mounted turbojets can be either Dassault M.D. 30 Viper (745 kg.=1,644 lb. s.t. each), Turbomeca Gabizo (1,100 kg.=2,425 lb. s.t. each) or Turbomeca Gabizo with reheat (1,500 kg.=3,306 lb. s.t. each.) All fuel and oxidant tanks in centre portion of fuselage. Oxidant tanks can be jettisoned quickly in an emergency.

ACCOMMODATION.—Single seat in pressurised cabin. Jettisonable canopy and lightweight ejection seat. All hydraulic, electrical and radio components mounted together in a single easily-accessible compartment immediately aft of cabin.

ARMAMENT.—Designed to carry an air-to-air guided missile under its fuselage.

DIMENSIONS.—
Span 6.90 m. (22 ft. 6 in.).
Length 13.00 m. (42 ft. 6 in.).
Height 3.20 m. (10 ft. 3 in.).

WEIGHTS.—
Weight empty, equipped 2,625 kg. (5,788 lb.).
Pilot 110 kg. (242 lb.).
Armament 150 kg. (330 lb.).
Fuel and oxidant 2,265 kg. (4,995 lb.).
Weight loaded 5,150 kg. (11,355 lb.).

PERFORMANCE.—
Max. speed Mach 1.95.
Landing speed approx. 185 km.h. (115 m.p.h.).
Time to 15,000 m. (50,000 ft.) from release of brakes 2 min. 30 sec.
Take-off run less than 500 m. (1,650 ft.).
Landing run less than 500 m. (1,650 ft.).

THE S.E. 3200 SUPER ALOUETTE.

The S.E. 3200 (originally S.E. 316) is a single-rotor helicopter under development for the French Government. Few details are available except that two prototypes are being built and that the S.E. 3200 will have three Turbomeca Turmo III shaft-turbine engines and accommodation for 20-28 passengers.

THE S.E. 3130 ALOUETTE II.

The S.E. 3130 Alouette II is a five-seat helicopter, the rotors of which are driven by a Turbomeca Artouste II shaft turbine. The prototype first flew on March 12, 1955 and was followed by a second prototype and a pre-production batch of three



The S.O. 3130 Alouette II equipped as an ambulance.



The naval version of the S.E. 3130 Alouette II.

aircraft, the last of which flew on March 6, 1956. A French Certificate of Airworthiness was granted to the Alouette II on May 2, 1957.

A total of 180 Alouette II's has been ordered for service with the French Army, Navy and Air Force. A number is also being built for civilian operators and sales have already been made to many foreign countries. In all, 107 Alouettes had been delivered to military and civil operators by the end of 1957, when the production rate was four military and six civil models per month.

The Alouette II is also being assembled and will eventually be manufactured under licence in the United States by the Republic Aviation Corporation.

The Alouette II was granted a Certificate of Airworthiness by the C.A.A. on January 14, 1958, and was the first French aircraft of any kind, and the first turbine-powered helicopter in the World, to receive American certification.

On June 13, 1958, an Alouette II set up five international helicopter records, including a height record of 11,015 m. (36,138 ft.) for all classes, a height record of 9,530 m. (31,266 ft.) in the 1,000-1,750 kg. category, and rate of climb records to 3,000 m. (9,842 ft.) in 5 min. 30 sec., to 6,000 m. (19,685 ft.) in 11 min. and to 9,000 m. (29,527 ft.) in 17 min. 45 sec.

TYPE.—Turbine-driven General Purpose Helicopter.

ROTORS.—Three-blade main rotor, two-blade anti-torque rotor. All-metal main rotor blades. Blades on articulated hinges and may be folded towards the rear. Rotor driven through planetary type gear-box (16 : 1 reduction), with free wheel for autorotation. Take-off drive for tail rotor at lower end of main gear-box, from where a torque shaft runs to a small gear-box which supports the tail rotor and houses the pitch change mechanism.

FUSELAGE.—Glazed cabin has light metal frame, centre and rear fuselage triangulated steel-tube framework. Rear fuselage detachable for surface transport.

LANDING GEAR.—Skid type with retractable wheels for ground manoeuvring. Pneumatic floats, inflatable in the air for normal or emergency landings on water, are available.

POWER PLANT.—One Turbomeca Artouste II shaft turbine developing 360 s.h.p. at 33,000 r.p.m. Maximum continuous power 320 s.h.p. Fuel tank (595 litres = 131 Imp. gallons) in centre fuselage.

ACCOMMODATION.—Glazed cabin seats pilot and passenger side-by-side in front and three passengers behind. Can be adapted for flying crane, ambulance, rescue, liaison, observation, training, agricultural, photographic and other duties. As an ambulance can accommodate two stretchers, two sitting casualties and a medical attendant.

DIMENSIONS.—
Main rotor diameter 10.20 m. (33 ft. 6 in.).
Tail rotor diameter 1.80 m. (5 ft. 11 in.).
Overall length, blades folded 9.7 m. (31 ft. 9½ in.).
Overall width 2.08 m. (6 ft. 10 in.).
Height 2.75 m. (9 ft.).

WEIGHTS.—
Weight empty 850 kg. (1,875 lb.).
Disposable load 650 kg. (1,425 lb.).
Normal loaded weight 1,500 kg. (3,300 lb.).
Max. loaded weight 1,600 kg. (3,527 lb.).



The S.E. 3130 Alouette II experimentally armed with S.S.II missiles.

PERFORMANCE (at 1,500 kg. = 3,300 lb. A.U.W.).—
Max. speed at S/L. 177 km.h. (110 m.p.h.).
Cruising speed at S/L. 170 km.h. (106 m.p.h.).
Rate of climb 270 m./min. (880 ft./min.).
Service ceiling 3,200 m. (10,500 ft.).
Hovering ceiling with ground effect 2,500 m. (8,200 ft.).
Cruising endurance 3 hrs. 15 min.
Economical cruising range 600 km. (373 miles).

THE S.E. GOUVERNEUR.

The Gouverneur is a civil "executive" transport version of the S.E. 3130 Alouette II, with more luxurious accommodation for a pilot and three passengers. Its fuselage is completely covered and streamlined, which adds 29 km.h. (18 m.p.h.) to the cruising speed at a cost of 75 kg. (160 lb.) reduction in payload. Otherwise, this aircraft is similar to the standard Alouette II. The prototype flew for the first time on May 10, 1957.



The Gouverneur, the civil executive version of the Alouette II.

THE S.E. 3140.

First announced in May, 1957, the S.E. 3140 is a new version of the S.E. 3130 Alouette II powered by a 400 s.h.p. Turbomeca Turmo II shaft-turbine. Being of the "free-turbine" type, this power plant will ensure greater flexibility of operation. In particular, jump take-offs will be possible without imposing strain on the transmission. The S.E. 3140 prototype made its first flight on May 16, 1957.

THE S.O. 1221 DJINN.

The S.O. 1221 is a two-seat turbine-powered helicopter in which the two-blade rotor is driven by compressed air supplied by a Turbomeca Palouste turbo-generator located in the fuselage. There are no combustion chambers at the rotor blade tips.

The prototype flew for the first time on December 16, 1953 and had a take-off weight of 600 kg. (1,320 lb.). This was increased subsequently to 700 kg. (1,540 lb.), then to 760 kg. (1,675 lb.), and finally to 800 kg. (1,765 lb.), which is the maximum take-off weight adopted for the current military production version. To comply with the requirements of the Civil Aviation Services, the civilian version has a reduced maximum take-off weight of 760 kg. (1,675 lb.).

The first pre-production Djinn flew on September 23, 1954, and the first production model on January 5, 1956. A French Certificate of Airworthiness was granted to the civil version on May 2, 1957.

Present orders cover the manufacture of more than 120 Djinns, of which 60 are for the French *Aviation Légère d'Artillerie*, three for the U.S. Army, six for the German Defence Ministry and others for civilian customers in many different countries. A total of 59 had been delivered by the end of 1957, not counting the pre-production series.

Djinns have been used for a considerable amount of experimental and development



The S.O. 1221 Djinn turbine-powered helicopter as an ambulance.

flying, including air-to-ground launching trials with the Nord S.S. 10 wire-guided antitank missile.

TYPE.—Two-seat Jet-driven Helicopter.

ROTOR.—Two-blade rotor on free tilting hub. Light alloy blades have extruded duralumin spar which is keyed to the box-type trailing-edge. Blades attached to blade roots by tensile steel straps which, in turn, are anchored to hub by sealed thrust ball bearings. Compressed air is fed to rotor-tip ejectors through hub, which has a rotating air-sealed joint, and ducts in blade leading-edges. Total disc area 95 m.² (1,022 sq. ft.).

FUSELAGE.—Welded steel-tube structure.

TAIL UNIT.—Cantilever monoplane type, with two end-plate fins and large central rudder which works in engine exhaust.

LANDING GEAR.—Skid type, with small retractable wheels to facilitate ground handling. Track 1.85 m. (6 ft.).

POWER PLANT.—One 240 h.p. Turbomeca Palouste IV turbo generator in fuselage supplies compressed air through trunk to rotor hub and blade ducts to rotor-tip ejectors. Fuel tank in fuselage. Fuel capacity 250 litres (55 Imp. gallons). Oil capacity 8 litres (1.76 Imp. gallons).

ACCOMMODATION.—Front of fuselage enclosed by transparent panels and side doors. Can accommodate pilot and passenger or pilot and two stretcher cases. Equipment, dependent on rôle, can include heater, VHF radio, agricultural spraying gear, load dropping gear, float landing gear, etc.

DIMENSIONS.—
Rotor diameter 11 m. (36 ft. 1 in.).
Length of fuselage 5.30 m. (17 ft. 4 in.).
Width of fuselage 1.95 m. (6 ft. 5 in.).



The S.O. 1221 Djinn turbine-powered Helicopter as a crop-sprayer.

Height (to top of rotor pylon) 2.62 m. (8 ft. 7 in.).

WEIGHTS.—
Weight empty 360 kg. (794 lb.).
Max. loaded weight (military version) 800 kg. (1,765 lb.).
Max. loaded weight (civil version) 760 kg. (1,675 lb.).

PERFORMANCE (at 700 kg. = 1,543 lb. A.U.W.).—
Max. speed 130 km.h. (80 m.p.h.).
Cruising speed 105 km.h. (66 m.p.h.).
Rate of climb at S/L. 210 m./min. (690 ft./min.).
Hovering ceiling with ground effect 1,500 m. (4,900 ft.).
Max. altitude for vertical take-off 2,800 m. (9,200 ft.).
Range at cruising speed 180 km. (112 miles).
Duration with normal tankage 2¼ hours.

WASSMER

SOCIÉTÉ DES ETABLISSEMENTS BENJAMIN WASSMER.

HEAD OFFICE: 13, RUE ETIENNE-DOLET, PARIS (20e).

WORKS: ISSOIRE (P.-DE-D.).

During 1957, this company built 35 Jodel D.112 and 60 Jodel D.120 light aircraft. Similar rates of production were anticipated for 1958, and the D.112 is also being manufactured now in kit form for construction by amateurs. The D.120 is built only by Wassmer and is not available in kit form.

Wassmer also began production of a pre-series of 12 of their Javelot W.A.-20 sailplanes early in 1958, and first deliveries were scheduled for the spring.

Other current activities include the development of a tandem two-seat training version of the Javelot and of a four-seat light aeroplane of Wassmer design. The latter is of conventional layout, with a 180 h.p. Lycoming engine and tricycle landing gear, and was scheduled to fly in October, 1958.

THE WASSMER JODEL D.120 PARIS-NICE.

The D.120, a de-luxe version of the Jodel D.112, is not intended for amateur production. The prototype flew on June 5, 1955 and the D.120 is now being built in quantity by Wassmer.

Among the many refinements introduced in the D.120 are a redesigned canopy to provide better rearward view; full upholstery in the cabin; radio as standard equipment; spatted wheels, etc. The power-plant is a 90 h.p. Continental C90-12F flat-four, which gives the aircraft a greatly improved performance.



The Wassmer Jodel D.120 Paris-Nice (90 h.p. Continental C90 engine).

DIMENSIONS.—
Span 8.22 m. (27 ft.).
Length 6.36 m. (20 ft. 10 in.).
Wing area 12.27 m.² (132 sq. ft.).

WEIGHTS.—
Weight empty 375 kg. (827 lb.).
Weight loaded 650 kg. (1,433 lb.).

PERFORMANCE.—
Max. speed 205 km.h. (127 m.p.h.).
Max. cruising speed 187 km.h. (116 m.p.h.).
Economical cruising speed 170 km.h. (106 m.p.h.).
Rate of climb at S/L 210 m./min. (690 ft./min.).
Ceiling 4,200 m. (13,780 ft.).
Max. range 1,150 km. (715 miles).

THE WASSMER JAVELOT W.A.20.

The Javelot is a single-seat high-performance sailplane of extremely-simple construction, which flew for the first time in August, 1956. The tubular-steel fuselage structure is made in two parts, the forward portion having four longerons and the rear portion only three. The wing is of wooden construction, with the spar at 37% of the chord, and is covered with wood forward of the spar and with fabric aft of the spar. A mono-wheel landing gear is fitted, with nose and tail skids.

A new version of the Javelot, known as the Javelot II, made its first flight on March 25, 1958. Fitted with a wing of 15 m. (49 ft. 2½ in.) span, it is eligible for the international Standard Class.

DIMENSIONS.—
Span 16.08 m. (52 ft. 9 in.).
Length 7.06 m. (23 ft. 2 in.).
Aspect ratio 16.7.
Wing area 15.50 m.² (166.8 sq. ft.).

WEIGHTS.—
Weight empty 227 kg. (500 lb.).
Weight loaded 324 kg. (714 lb.).

PERFORMANCE.—
Best glide ratio at 77 km.h. (48 m.p.h.) 28 : 1.
Min. sinking speed at 72.4 km.h. (45 m.p.h.) 0.76 m./sec. (2.50 ft./sec.).

GERMANY

THE GERMAN FEDERAL REPUBLIC

AERO

AERO FLUGZEUGBAU HUBERT ZUERL.

HEAD OFFICE AND WORKS: MUNICH-HEIMSTETTEN, NR. MUNICH-RIEM AIRPORT.

This company was founded by Hubert Zuerl, publisher of the magazine *Aero*, to promote both amateur and industrial construction of light planes of French Jodel design, for which he has acquired the licence rights in Germany and Austria.

Herr Zuerl has adapted the designs of the Jodel models D.9 and D.11 to meet German airworthiness requirements, including the S-4 Category covering training aircraft. Finnish birch or German beech plywood is used throughout, instead of French okoumé plywood. The resulting somewhat higher take-off weight has been more than offset by adapting the designs to take more powerful engines.

Aero Flugzeugbau Hubert Zuerl supplies plans, amateur construction kits, finished component parts or factory-built aircraft.

THE AERO JODEL D.9A BÉBÉ.

Although basically similar to the standard Jodel D.9, this version has been modified to meet German airworthiness requirements.

The three prototypes were fitted respectively with single and dual-ignition Volkswagen engines and an adaptation of the 1.5 litre Porsche automobile engine. Production D.9A's have a 52 h.p. Porsche 678/3 aircraft engine, which gives them a much higher performance than the standard D.9 Bébé.



The Aero Jodel D.11 Club (65 h.p. Continental A65 engine).

THE AERO JODEL D.11 CLUB.

Aero Flugzeugbau Hubert Zuerl has modified the basic Jodel D.11 design to enable it to conform with German airworthiness requirements in the S-4 (training) category. One major change is that the box-spar is now built in laminated form, to absorb a landing impact of more than 3 m./sec. (9.84 ft./sec.), and it is a condition of the supply of plans and kits of the Aero-Jodel D.11 that the spars must be supplied by this company exclusively. Installation of a Hausler electric starter is also obligatory to meet German Federal Bureau of Aviation requirements.

Four versions of the Aero-Jodel D.11 have been announced:—

D.11A. Basic version with 65 h.p. Continental A65 engine. Obtained German C. of A. in May, 1957.

D.11B. Projected version with 65 h.p. Walter Mikron engine.

D.11C. Available with 90 h.p. Continental C-90-12F engine and radio. Suitable for glider towing.

D.11D. Projected version with 65 h.p. Porsche 678/1 engine.

BLUME

INGENIEUR-BÜRO BLUME.

HEAD OFFICE: TAUSENDFENSTERHAUS, DUISBURG-RUHRORT.

Professor Dipl.-Ing. Walter Blume, chief designer and managing director of the former Arado company, has designed a four-seat all-metal touring and sports aircraft as a replacement for his successful pre-war Arado 79 design. A prototype, known as the Bl.500 was built by the Focke-Wulf company, with which Prof. Blume's "bureau" is associated. It made its first flight on March 14, 1957.

The description which follows refers to the Bl.502 production version, with 150 h.p. Lycoming engine.

THE BLUME Bl. 500.

TYPE.—Four-seat light cabin monoplane.

WINGS.—Low-wing cantilever monoplane. Aspect ratio 7.35. All-metal structure. Parallel chord centre-section and tapered outer wings. Dihedral on outer panels only. Fixed tip fairings act as end-plates to increase effective span. Split flaps on outer wings; slotted flaps on centre-section. Wing area 15 m.² (161.5 sq. ft.).

FUSELAGE. —Semi-monocoque all-metal structure.

TAIL UNIT.—Cantilever monoplane type. All metal structure. Manually-operated trim-tabs in elevators.

LANDING GEAR.—Retractable nose-wheel type. Main wheels retract upwards and protrude slightly from wings in "up" position to reduce damage in a wheels-up landing. Wheel track 2.10 m. (6 ft. 10 in.).

POWER PLANT.—One 150 h.p. Lycoming O-320-A four-cylinder, horizontally-opposed air-cooled engine, driving two-blade variable-pitch propeller. Two fuel tanks in wing centre-section, one on each side of fuselage.

ACCOMMODATION.—Enclosed cabin for four persons. Entry by opening upward both sides of canopy, which are hinged on centre-line. Air conditioned cabin.



Two views of the Blume Bl. 500 (150 h.p. Lycoming O-320 engine).

DIMENSIONS.—
Span 10.50 m. (34 ft. 5 in.).
Length 8.15 m. (26 ft. 9 in.).
Height 2.40 m. (7 ft. 10½ in.).

WEIGHTS.—
Weight empty, equipped 670 kg. (1,478 lb.).
Weight loaded (2 seats, aerobatic) 970 kg. (2,140 lb.).
Weight loaded (4 seats) 1,120 kg. (2,470 lb.).
Wing loading 64.7-74.7 kg./m.² (13.2-15.3 lb./sq. ft.).
Power loading 6.47-7.47 kg./h.p. (14.2-16.5 lb./h.p.).

PERFORMANCE.—
Max. speed 250 km.h. (155.5 m.p.h.).
Cruising speed (70% power) 220 km.h. (137 m.p.h.).
Landing speed 85 km.h. (52.5 m.p.h.).
Rate of climb at S/L. 300 m./min. (1,005 ft./min.).
Ceiling 4,800 m. (15,750 ft.).
Take-off distance to 15 m. (50 ft.) 375 m. (1,230 ft.).
Range 900 km. (560 miles).
Endurance 4.1 hours.

BORGWARD

CARL F. W. BORGWARD G.m.b.H.

HEAD OFFICE AND WORKS: BREMEN.

This famous automobile-manufacturing company has produced the prototype of a light helicopter designed by Prof. Dr. Ing. E. H. Focke, whose Focke-Wulf Fw.61 aircraft of 1937 was one of the earliest successful helicopters. Only the following brief details were available at the time of writing.

THE BORGWARD KOLIBRI I.

The Kolibri I is a three-seat light helicopter, powered by a 260 h.p. Lycoming VO-435-A1A six-cylinder horizontally-opposed air-cooled engine, and with a designed cruising speed of approximately 160 km.h. (100 m.p.h.). The prototype made its first free flight on July 8, 1958, piloted by Herr Ewald Rohlfs, who set up several international helicopter records in the pioneer Fw.61 in 1937.

BURGFALKE

BURGFALKE FLUGZEUGBAU.

HEAD OFFICE AND WORKS : BURGLENGENFELD, BEI REGENSBURG, BAVARIA.

Director : Ing. M. J. Dahmen.

This company is developing a two-seat semi-aerobatic light aircraft known as the M-150 Schulmeister, which is based on the A15 (WN-16) aircraft designed by the former Wiener-Neustadt company.

Burgfalke also produces the well-known series of Scheibe and Vogt sailplanes.

THE BURGFALKE M-150 SCHULMEISTER (SCHOOLMASTER).

TYPE.—Two-seat "Pusher" monoplane.

WINGS.—Cantilever low-wing monoplane. NACA 23 series wing section. Aspect ratio 7.15. Wooden structure with plywood-covered leading edge and undersurfaces, rest fabric-covered. Wing area 13.50 m.² (145.3 sq. ft.).

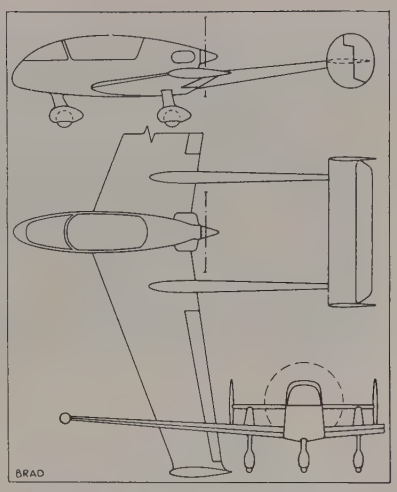
FUSELAGE.—Tubular structure, using chrome-molybdenum steel tube in highly-stressed parts and commercial steel tube elsewhere. Fabric-covered.

TAIL UNIT.—Cantilever monoplane type with twin fins and rudders, carried on twin tail-booms. All-wood construction.

LANDING GEAR.—Fixed tricycle type. Rubber-in-compression shock-absorbers. Brakes on main wheels. Steerable nose-wheel. Wheel spats. Wheel track 2.20 m. (7 ft. 3 in.).

POWER PLANT.—One 65 h.p. Continental A65 four-cylinder horizontally-opposed air-cooled engine, arranged as "pusher" and driving a Hoffmann two-blade wooden propeller. Alternatively a 55 or 75 h.p. Porsche engine. Fuel tank in fuselage forward of engine. Provision for wing-tip tanks.

ACCOMMODATION.—Two seats in tandem under large transparent canopy. Dual controls and instruments optional.



The Burgfalke M-150 Schulmeister.

DIMENSIONS.—
Span 9.84 m. (32 ft. 4 in.).
Length 7.27 m. (23 ft. 10 in.).
Height 1.80 m. (5 ft. 11 in.).

WEIGHTS AND LOADINGS.—
Weight empty 350 kg. (772 lb.).
Max. loaded weight 590 kg. (1,300 lb.).
Wing loading 40.7 kg./m.² (8.33 lb./sq. ft.).
Power loading 11.0 kg./h.p. (24.25 lb./h.p.).

PERFORMANCE (estimated).—
Max. speed 175 km.h. (109 m.p.h.).
Cruising speed 145 km.h. (90 m.p.h.).
Landing speed 60 km.h. (37 m.p.h.).
Ceiling 4,200 m. (13,780 ft.).
Normal range 500 km. (310 miles).

THE VOGT LO 100 ZWERGREIHER (HERON).

First fully-aerobatic sailplane built in Germany after the war, the single-seat Vogt LO 100 is being built by Burgfalke for both training and sporting flight. Externally, it is similar to the well-known Habicht sailplane, but is smaller and of very simple construction.

DIMENSIONS.—
Span 10.0 m. (32 ft. 9½ in.).
Length 6.17 m. (20 ft. 3 in.).
Height 1.60 m. (5 ft. 3 in.).

WEIGHTS.—
Weight empty 140 kg. (309 lb.).
Weight loaded 245 kg. (540 lb.).
Wing loading 22.47 kg./m.² (4.60 lb./sq. ft.).

PERFORMANCE.—
Max. permissible speed 360 km.h. (224 m.p.h.).
Min. speed 48 km.h. (30 m.p.h.).
Sinking speed (15° flaps) 0.78 m./sec. (2.56 ft./sec.).
Best glide ratio 28 : 1 at 85 km.h. (53 m.p.h.).

THE VOGT LO 150.

The Vogt LO 150 is identical with the LO 100 except that it is fitted with a wing of increased span for high-performance flying. This enables the same sailplane to be used for a variety of purposes by use of the two alternative wings.

The prototype LO 150 was completed at the end of 1953 and was test flown by the Alpine sailplane research group at Munich before being offered for production by Burgfalke.

DIMENSIONS.—
Same as LO 100 except :
Span 15.0 m. (49 ft. 3 in.).

WEIGHTS.—
Weight empty 192 kg. (423 lb.).
Weight loaded 295 kg. (650 lb.).
Wing loading 27 kg./m.² (5.53 lb./sq. ft.).

PERFORMANCE.—
Min. sinking speed 0.68 m./sec. (2.23 ft./sec.).
Best glide ratio approx. 30 : 1.

DITTMAR

MÖWE-FLUGZEUGBAU HEINI DITTMAR.

ADDRESS : BÜRGERMEISTER FISCHER STR. 12/IV, AUGSBURG.

Technical Director : Dipl.-Ing. Horst Rabsilber.

Commercial Director : James G. Lau.

Heini Dittmar, the well-known glider expert, has built the prototype of a two-seat light club and touring aircraft known as the HD 153 Möwe. The prototype made its first flight in November, 1953 and has been tested with various engines including a 65 h.p. Continental and 70 h.p. Hirth HM.60. The first production model with a 90 h.p. Continental engine flew in May, 1956.

THE DITTMAR MÖWE.

Two versions of the Möwe are available, as follows :—

HD 153 Möwe. Standard version with two seats side-by-side.

HD 156 Möwe. Basically as HD 153, but with a third seat and additional side windows to rear of cabin.

TYPE.—Two/three-seat Light monoplane.

WINGS.—Cantilever high-wing monoplane. Göttingen 367 (modified) wing section. Aspect ratio 8.5. Dihedral 2°. Single-spar wooden structure, with plywood-covered leading-edge torsion box and fabric-covering overall. Wooden ailerons and flaps. Total area of ailerons 1.32 m.² (14.2 sq. ft.). Total area of flaps 0.15 m.² (1.61 sq. ft.). Gross wing area 18.3 m.² (197 sq. ft.).

FUSELAGE.—Wooden frames and stringers, plywood-covered.

TAIL UNIT.—Cantilever monoplane type, without fixed fin. Wooden structure with plywood covering Areas : rudder 0.98 m.² (10.55 sq. ft.), tailplane 1.56 m.² (16.79 sq. ft.), elevators 1.0 m.² (10.76 sq. ft.). Tailplane span 2.80 m. (9 ft. 2 in.).

LANDING GEAR.—Fixed tricycle type. Rubber springing on main wheels. Nose-wheel on spring-loaded strut. All wheels FAGU-Rad 380 × 150 with FAGU-Bremsen brakes. Steerable nose-wheel. Wheel spats optional. Wheel track 1.90 m (6 ft. 3 in.). Wheelbase 1.40 m. (4 ft. 7 in.).

POWER PLANT.—One 90 h.p. Continental C90 12F four-cylinder horizontally-opposed air-cooled engine, with Hoffmann "Hoco" two-blade fixed-pitch wooden airscrew. Fuel in two tanks in wing centre-section, each of 70 litres (15.4 Imp. gal.) capacity. Oil capacity 4.5 litres (1 Imp. gal.).

ACCOMMODATION.—Enclosed cabin seating two side-by-side in HD 153, with additional seat to rear in HD 156. Luggage space aft of seats.

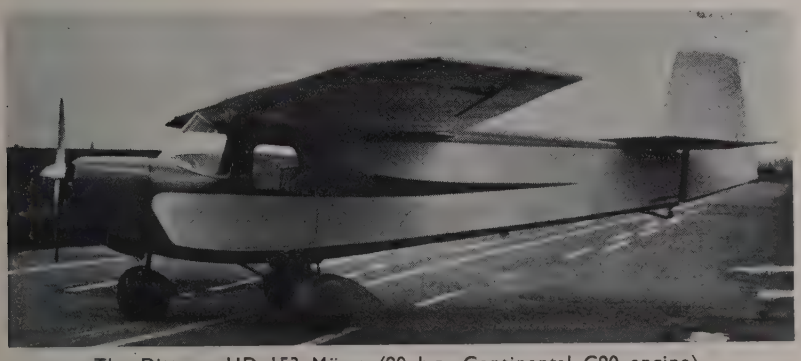
DIMENSIONS.—
Span 12.0 m. (39 ft. 4 in.).
Length 6.5 m. (21 ft. 4 in.).
Height 2.10 m. (6 ft. 10½ in.).

WEIGHTS.—
Weight empty, equipped 465 kg. (1,025 lb.).
Weight loaded 760 kg. (1,675 lb.).

PERFORMANCE.—
Max. speed 170 km.h. (106 m.p.h.).
Cruising speed 150 km.h. (93 m.p.h.).
Landing speed 65 km.h. (40 m.p.h.).
Time to 1,000 m. (3,280 ft.) 6 min.
Service ceiling 4,500 m. (14,760 ft.).
Take-off distance 150 m. (492 ft.).
Landing distance 130 m. (425 ft.).
Range 1,000 km. (620 miles).



The Dittmar HD 156 Möwe (90 h.p. Continental C90 engine).



The Dittmar HD 153 Möwe (90 h.p. Continental C90 engine).

DORNIER

DORNIER-WERKE G.m.b.H.

HEAD OFFICE: FRIEDRICHSHAFEN a.B.

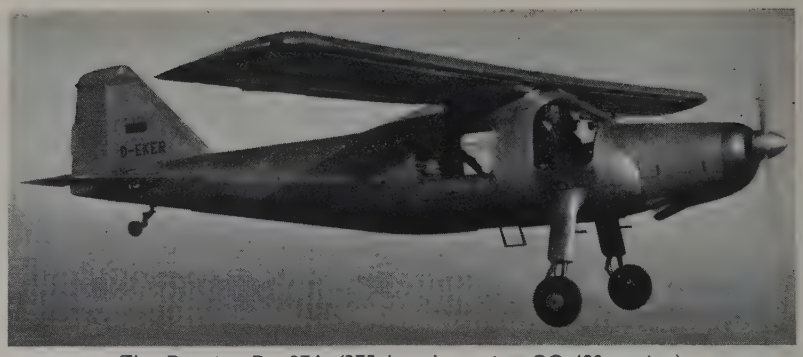
MAIN FACTORIES: BRUNHAMSTRASSE, 21, NEUAUBING, NEAR MUNICH.

AIRFIELD: OBERPFAFFENHOFEN, BAVARIA.

Founder and Director: Prof. Dr. Claude Dornier.

During their four decades in the aircraft industry, the Dornier-Werke G.m.b.H., formerly Dornier-Metallbauten, have built many famous types, including the Wal flying boat, the Do X which was the largest flying boat of its day, the Do 17 bomber and the Do 335 twin-engined fighter with tractor and pusher airscrews.

After the war, when the design and manufacture of aircraft in Germany was forbidden, Dr. Dornier established technical offices in Madrid, Spain, where he designed a general purpose monoplane known as the Do 25. Now that aircraft production is again possible in Germany, an advanced development of this aircraft designated the Do 27 is being built by the new Dornier-Werke. 428 Do 27's have been ordered for the new German Air Force. Deliveries, at a rate of nearly 20 aircraft a month, totalled well over 100 by mid-1958.



The Dornier Do 27A (275 h.p. Lycoming GO-480 engine).

THE DORNIER Do 27.

The prototype Do 27 flew for the first time on June 27, 1955, and the first production aircraft on October 17, 1956.

There are four versions of the Do 27, as follows:—

Do 27A. Basic version for military observation, liaison, light transport and casualty evacuation duties.

Do 27R. Similar to Do 27A, but with dual controls, enabling it to be used also for training.

Do 27Q. Projected civil version of Do 27A.

Do 27S. Seaplane version of Do 27A.

All versions are powered normally by a 275 h.p. Lycoming GO-480-B1A6 engine, but are available also with a 340 h.p. Lycoming GSO-480-B1B6 engine.

TYPE.—Single-engined General-purpose monoplane.

WINGS.—High-wing cantilever monoplane. Wing section NACA 23018 (modified). Aspect ratio 7.42. Chord 1.65 m. (5 ft. 5 in.). No dihedral. Incidence 4.5°. All metal box-spar structure. Forward portion of wing is a metal-skinned torsion box with a built-in fixed slot over entire span. Rear portion of wing is fabric-covered. Wingtips are metal-covered. Double-slotted ailerons have metal structure with fabric covering. Double-slotted flaps have metal structure, partly fabric-covered. Total area of ailerons 2.65 m.² (28.5 sq. ft.). Total area of flaps 3.6 m.² (38.75 sq. ft.). Gross wing area 19.4 m.² (208.8 sq. ft.).

FUSELAGE.—All-metal monocoque structure.

TAIL UNIT.—Cantilever monoplane type. All-metal structure with fabric-covered rudder and elevators. Variable-incidence tailplane. Total area of tailplane and elevators 4 m.² (43 sq. ft.). Total area of fin and rudder 2.56 m.² (27.5 sq. ft.). Tailplane span 3.8 m. (12 ft. 4 in.).

LANDING GEAR.—Fixed tail-wheel type. Cantilever main wheel units with oleo-pneumatic shock absorbers and Goodyear hydraulic brakes. Tail-wheel has rubber shock-strut. Goodyear main wheels size 530 × 216 mm. Tail-wheel size 200 mm. Wheel track 2.29 m. (7 ft. 6 in.). Wheelbase 6.40 m. (21 ft.). Alternatively, all versions can be fitted with a wheel-ski type of landing gear, with hydraulically-retracted skis on the standard wheels, or floats, or the Bonmartini type of rubber-track landing gear for operation on rough airfields.

POWER PLANT.—One 275 h.p. Lycoming GO-480-B1A6 six-cylinder horizontally-opposed air-cooled engine, or 340 h.p. Lycoming GSO-480-B1B6 six-cylinder horizontally-opposed air-cooled supercharged engine. The GO-480-B1A6 drives a 2.48 m. (8 ft. 2 in.) diameter two-blade Hartzell airscrew. Fuel in two wing tanks, with a total capacity of 220 litres (48.4 Imp. gallons). Oil capacity 10 litres (2.2 Imp. gallons).

ACCOMMODATION.—Enclosed cabin seating up to five persons in military version and six persons in civil versions. Dual controls in Do 27B. Four large entry doors. Cabin volume 3.50 m.³ (123.6 cub. ft.).

DIMENSIONS.—
Span 12 m. (39 ft. 4½ in.).
Length 9.6 m. (31 ft. 6 in.).
Height 3.5 m. (11 ft. 6 in.).

WEIGHTS.—
Weight empty 985 kg. (2,167 lb.).
Weight loaded (Do 27A and B) 1,570 kg. (3,460 lb.).
Weight loaded (Do 27Q and S) 1,750 kg. (3,858 lb.).

PERFORMANCE (with 275 h.p. engine and A.U.W. of 1,570 kg. = 3,460 lb.).—
Max. speed at 1,000 m. (3,280 ft.) 250 km.h. (155 m.p.h.).
Cruising speed (56% power) 205 km.h. (127 m.p.h.).
Stalling speed 58 km.h. (36 m.p.h.).
Landing speed 65 km.h. (40.4 m.p.h.).
Climb to 1,000 m. (3,280 ft.) 2.6 min.
Climb to 2,000 m. (6,560 ft.) 6.5 min.
Climb to 3,000 m. (9,840 ft.) 12 min.
Climb at 4,500 m. (14,750 ft.) 26.5 min.
Ceiling 5,500 m. (18,040 ft.).
Take-off to clear 15 m. (50 ft.), max. fuel, no wind 170 m. (186 yds.).
Landing from 15 m. (50 ft.) no wind 160 m. (175 yds.).
Cruising range 870 km. (540 miles).



The Dornier Do 27A equipped with a combined wheel/ski landing gear.

FOCKE-WULF

FOCKE-WULF G.m.b.H.

HEAD OFFICE AND WORKS: HÜNEFELDSTRASSE 1-5, BREMEN-FLUGHAFEN.

Directors: Arthur Rothe and Hans Georg Scheffler.

The reconstituted Focke-Wulf company has its administrative building and small workshops at Bremen Airport, where, in 1951, a nucleus of 200 skilled workers began by building Kranich III and Weihe gliders and general engineering products. In the meantime the workshops have been extended considerably and to-day a staff of approximately 850 is employed.

The company is grouped with the engineering office of Professor Blume at Duisburg, and the prototype of the Blume 500 was built by Focke-Wulf.

The Focke-Wulf-Blume group is building under licence the Piaggio P.149D training and liaison aircraft for the German Air Force. The components for an initial batch of 75 of the 194 ordered by the German Federal Republic are being supplied by the Piaggio company for assembly by Focke-Wulf. The remainder will be manufactured entirely by Focke-Wulf. Piaggio is providing technical assistance and is also supplying the Lycoming GO-480-B1A6 engines, which Piaggio builds under licence, as well as airscrews for all the P.149D's.

Focke-Wulf is responsible for the maintenance and overhaul of the Sea Hawk fighters of the German Navy, and it is also giving attention to the development of aircraft of its own design.

HAMBURGER

HAMBURGER FLUGZEUGBAU G.m.b.H.

HEAD OFFICE AND WORKS: KREETSLAG 10, HAMBURG-FINKENWERDER.

ADDRESS: POSTFACH 11524, HAMBURG-FINKENWERDER.

This is the aviation division of the great Blohm and Voss ship-building company, which built many seaplanes for the pre-war Lufthansa and for the old *Luftwaffe*. It is one of the three companies making up the Flugzeugbau Nord G.m.b.H. group, which is manufacturing the French Nord 2501 Noratlas transport under licence. Hamburger is responsible for the production of Noratlas fuselages, as well as for the final assembly and flight testing.

The first German-built Noratlas flew for the first time on August 6, 1958.

Hamburger is also working on projects for freight and passenger carrying aircraft of its own design. Plans to produce a turboprop version of the Spanish CASA-207 Azor transport have, however, been abandoned.

HEINKEL

ERNST HEINKEL FAHRZEUGBAU G.m.b.H.

HEAD OFFICE AND WORKS: SPEYER A. RHEIN.

President and General Manager: Alfred Klein.

Vice-President (Production): F. Fr. C. Walter.

Vice-President (Research and Development): Prof. Dr. Ing. K. Thalau.

Director (Sales): Fr. W. Seekatz.

Director (Design): Karl Schwärzler.

Director (Research): Prof. Dr. Ing. Ruden.

Chief Project Engineer: Dipl. Ing. S. Günter.

The original Heinkel company was formed by the late Dr. Ernst Heinkel in 1922 and was responsible for many famous aircraft including the He 178, the first turbojet-powered aircraft to fly, in August, 1939.

Initially, the new company is co-operating with Messerschmitt A.G. to produce the French Fouga Magister jet-trainer under licence for the new German Air Force. It also undertakes aircraft overhaul and repair.

The project and design office is concerned with research and development of high-performance aircraft, but no details are available at the present time.

JUNKERS

JUNKERS FLUGZEUG-UND MOTOREN-WERKE G.m.b.H.

HEAD OFFICE: TÖLZERSTRASSE 40, MUNICH 25.

Commercial Managers: Dr. Ing. Fritz Gosslau and Hans Frieseke.

This company has been formed by the amalgamation of the operating groups of the former Junkers, Messerschmitt and Heinkel companies. It will be engaged exclusively in the development of modern aeronautical propulsion units.

A new board and a new commercial management have been appointed, but the organisation of the new company is still in the preparatory stages and it will be some time before it will be in a position to announce its future plans.

KLEMM

HANNS KLEMM FLUGZEUGBAU, LEICHTFLUGZEUGBAU KLEMM G.m.b.H.

HEAD OFFICE: KARL BENZ-STRASSE, BÖBLINGEN, WÜRTTEMBERG.

Dr.-Ing. Hanns Klemm joined the design office of the Dornier company in 1917 and, after a brief period with this company and with Heinkel, was appointed chief aircraft designer of Daimler-Motor-engesellschaft. By 1924, he had perfected the design of a light plane known as the Klemm-Daimler L15, with a 12.5 h.p. Indian engine. This was followed by the L20 cantilever low-wing monoplane, with 20 h.p. Mercedes engine, which achieved great success and formed the basis of all subsequent Klemm light aeroplane designs.

In December, 1926, Dr. Klemm formed his own manufacturing company, the Leichtflugzeugbau Klemm, which produced large numbers of sporting aircraft before the outbreak of war in 1939.

The Klemm works were destroyed completely during the war. In 1955 a prototype of the wartime-designed Kl 107 light aircraft was completed, and a further developed version, the Kl 107B, the prototype of which first flew on September 4, 1956, is now being produced in series.



The Klemm Kl 107B two-seat Light Monoplane (150 h.p. Lycoming O-320 engine).

THE KLEMM Kl 107B.

TYPE.—Two-seat Light monoplane.

WINGS.—Cantilever low-wing monoplane. Wing section NACA 230 series. Aspect ratio 8. Mean chord 1.44 m. (4 ft. 9 in.). Dihedral 6°. Single-spar wooden structure with plywood covering forward of spar and fabric covering aft of spar. Wooden ailerons with plywood leading-edge and fabric covering. Wooden split flaps. Total area of ailerons 1.20 m.² (12.92 sq. ft.). Total area of flaps 0.89 m.² (9.58 sq. ft.). Gross wing area 14.6 m.² (157.15 sq. ft.).

FUSELAGE.—Wooden monocoque structure.

TAIL UNIT.—Wooden monoplane structure, plywood and fabric-covered. Areas: fin 0.65 m.² (7 sq. ft.), rudder 0.75 m.² (8.07 sq. ft.), elevators 1.0 m.² (10.76 sq. ft.), tailplane 1.46 m.² (15.72 sq. ft.). Tailplane span 3.30 m. (10 ft. 10 in.).

LANDING GEAR.—Fixed tail-wheel type. Klemm shock absorbers. Dunlop Av 660 wheels. Dunlop hydraulic plate brakes. Wheel track 1.634 m. (5 ft. 4 in.).

POWER PLANT.—One 150 h.p. Lycoming O-320-A2A four-cylinder horizontally-opposed air-cooled engine. Hoffmann two-blade wooden airscrew. Fuel in two tanks in fuselage of 80 litres (17.6 Imp. gallons) and 45 litres (9.9 Imp. gallons) capacity respectively. Oil capacity 5 litres (1 Imp. gallon).

ACCOMMODATION.—Enclosed cabin normally seating two side-by-side, but with room for third seat behind. Dual controls.

DIMENSIONS.—
Span 10.88 m. (35 ft. 8 in.).
Length 8.30 m. (27 ft. 3 in.).
Height 2.15 m. (7 ft. 1 in.).

WEIGHTS.—
Normal weight loaded (3 persons) 940 kg. (2,072 lb.).
Weight loaded (semi-aerobatic, 2 persons) 830 kg. (1,830 lb.).

PERFORMANCE.—
Max. speed 215 km.h. (131 m.p.h.).
Landing speed 80 km.h. (50 m.p.h.).
Rate of climb at S/L 252 m./min. (827 ft./min.).



The Klemm Kl 107B (150 h.p. Lycoming O-320 engine).

MESSERSCHMITT

MESSERSCHMITT A.G.

HEAD OFFICE AND WORKS: HAUNSTETTERSTRASSE 148, AUGSBURG.

OTHER WORKS: MUNCHEN-RIEM AIRPORT.

Chairman: Dr. L. S. Rothe.

Technical Director: Hubert Bauer.

Commercial Director: Siegfried Keller.

In collaboration with the Heinkel company, the re-constituted Messerschmitt A.G. has formed the Flugzeug Union Sud group to undertake the manufacture under licence of the French Fouga Magister advanced jet trainer, for the German Air Force.

Messerschmitt is also engaged on aircraft repair and maintenance at its Munchen-Riem workshops.

PÜTZER

ALFONS PÜTZER KG.

ADDRESS: 133 BORNHEIMER STRASSE, BONN.

Following considerable development flying with a prototype two-seat light aeroplane named the Motorraab, Alfons Pützer KG. has produced a much-improved design which is now in production as the Elster. Descriptions of both the Motorraab and Elster are given hereafter.

THE PÜTZER MOTORRAAB.

The Motorraab was produced virtually by fitting a 30 h.p. modified Volkswagen automobile engine and a tricycle landing gear to a standard Pützer Doppelraab sailplane airframe. Its general appearance is shown in the accompanying illustration.

The enclosed cabin seats two persons in tandem, with the rear seat raised slightly above the level of the pilot's seat.

DIMENSIONS.—
Span 13.40 m. (43 ft. 11 in.).
Length 5.50 m. (18 ft. 0½ in.).

WEIGHTS.—
Weight empty 320 kg. (705 lb.).
Weight loaded 550 kg. (1,213 lb.).

PERFORMANCE.—
Cruising speed 100 km.h. (62 m.p.h.).
Landing speed 45 km.h. (28 m.p.h.).

Rate of climb at S/L 96 m./min. (315 ft./min.).
Take-off distance to 15 m. (50 ft.) 220 m. (720 ft.).
Range 550 km. (340 miles).

THE PÜTZER ELSTER (MAGPIE).

TYPE.—Two-seat light monoplane.

WINGS.—Braced high-wing monoplane, with single streamlined metal bracing strut each side. Dihedral 2°. Single-spar wooden structure with leading-edge torsion box. Flaps fitted. Wing area 18.0 m.² (193.75 sq. ft.).

FUSELAGE.—Plywood monocoque structure.

TAIL UNIT.—Braced monoplane type. Tailplane wire-braced.

LANDING GEAR.—Non-retractable tricycle type.

POWER PLANT.—One 52 h.p. Porsche 678/3 four-cylinder horizontally-opposed air-cooled engine, driving wooden two-blade fixed-pitch airscrew. Fuel capacity 68 litres (15 Imp. gallons).

ACCOMMODATION.—Pilot and passenger side-by-side in enclosed cabin, with upward-hingeing door each side. Dual controls. Sound-proofing. Width of cabin 1.14 m. (3 ft. 9 in.).

DIMENSIONS.—
Span 13.82 m. (45 ft. 4 in.).
Length 7.00 m. (22 ft. 11 in.).
Height 2.00 m. (6 ft. 6½ in.).

WEIGHTS.—
Weight empty 400 kg. (882 lb.).
Weight loaded 650 kg. (1,435 lb.).
Wing loading 32.5 kg./m.² (6.65 lb./sq. ft.).
Power loading 11.5 kg./h.p. (25.35 lb./h.p.).





Above, the Pützer Motorraab and, *below*, the Pützer Elster.

PERFORMANCE.—
Max. speed at S/L 140 km.h. (87 m.p.h.).
Cruising speed 130 km.h. (81 m.p.h.)
Landing speed 60 km.h. (37 m.p.h.).
Take-off distance from grass, zero wind 150-240 m. (490-785 ft.).
Range 650 km. (400 miles).

RFB

RHEIN-FLUGZEUGBAU G.m.b.H.

HEAD OFFICE AND WORKS: ARNDTSTRASSE 60, KREFELD-UERDINGEN.

OTHER WORKS: MÜNCHEN-GLADBACH.

Rhein-Flugzeugbau have obtained the licence from Rhein-West-Flug, Fischer u. Companie, for the production in quantity of the RW.3 aircraft in which forward thrust is provided by an airscrew mounted in a slot between the fin and rudder. This enables the airscrew to be housed vertically in the slot during motorless flight to offer minimum drag.

Series production of the RW.3 was started in the RFB works at Krefeld-Verdingen on September 1, 1957, and the first production model flew on February 8, 1958.

Standard production version is the RW.3-A3 with short-span wings; optional equipment includes wing extensions to convert the aircraft into the RW.3-A2 power-assisted glider version which has excellent soaring characteristics. Normally, it is supplied with a 65 h.p. Porsche engine, but the 95 h.p. Continental engine is available as an alternative power plant. Other optional extras include a variable-pitch airscrew, VHF radio, and turn and bank indicator.

THE RFB RW.3-A3 MULTOPLANE.

This version of the RW.3 is an aerobatic and sporting aircraft. It is basically similar to the RW.3-A2, but has short-span wings, with auxiliary fuel tanks fitted to the wing-tips.

TYPE.—Two-seat Light monoplane.

WINGS.—Shoulder-wing cantilever monoplane. NACA 747 A315 wing section. Aspect ratio 7.15. Chord 1.75 m. (5 ft. 9 in.) at root, 1.04 m. (3 ft. 5 in.) at tip. Dihedral 1.5°. Incidence 1°. All-metal structure with Pantal light alloy covering. Wings can be folded for stowage and towing on ground behind car. Plain light alloy ailerons with fabric covering. Light alloy flaps with fabric covering. Total area of ailerons 1.11 m.² (11.9 sq. ft.). Total area of flaps 1.62 m.² (17.4 sq. ft.). Gross wing area 14 m.² (150.7 sq. ft.).

FUSELAGE.—Welded tubular steel structure, with plastic skin covering.

TAIL UNIT.—Cantilever monoplane type, with horizontal surfaces mounted at tip of fin. Slot between fin and rudder in which airscrew is mounted. All-metal structure; fin and tailplane have Pantal light alloy covering, rudder and elevators fabric-covered. Areas: fin 0.78 m.² (8.35 sq. ft.), rudder 8.00 m.² (8.6 sq. ft.), tailplane 1.67 m.² (18.0 sq. ft.), elevators 2.57 m.² (27.7 sq. ft.). Tailplane span 3.19 m. (10 ft. 6 in.).

LANDING GEAR.—Retractable tricycle type, with additional sprung under-fuselage skid. Initial production aircraft have rubber shock-absorption. Later aircraft will have Gomolzig oleo-pneumatic shock-absorbers. Mechanical retraction. Main wheels size 380×150 mm. (14.96×5.61 in.). Castering nose-wheel size 260×85 mm. (10.24×3.35 in.). Mechanically-operated brakes on main wheels. Wheel track 1.85 m. (6 ft. 1 in.). Wheelbase 2.50 m. (8 ft. 2½ in.).

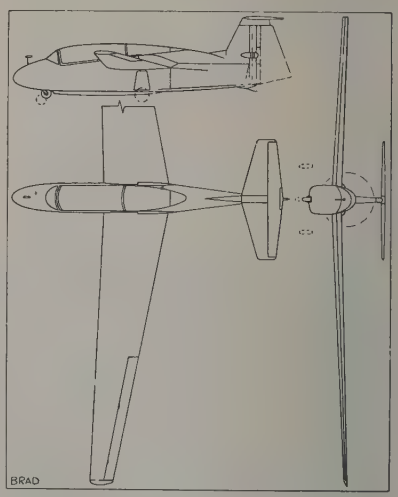
POWER PLANT.—One 65 h.p. Porsche Type 678/0 four-cylinder horizontally-opposed air-cooled engine or one 95 h.p. Continental C90-12F four-cylinder horizontally-opposed air-cooled engine, driving either a Hoffmann two-blade fixed-pitch airscrew or a Hoffmann Hocomat two-blade variable-pitch airscrew. Fuel in two tanks in wing roots, each with capacity of 40 litres (8.8 Imp. gallons). Provision for two auxiliary wing-tip tanks, each with capacity of 30 litres (6.6 Imp. gallons). Maximum total fuel capacity 140 litres (30.8 Imp. gallons). Oil capacity 5.5 litres (1.21 Imp. gallons).

ACCOMMODATION.—Enclosed cabin seating two in tandem. Rearward-sliding transparent canopy. Rear seat slightly raised.

DIMENSIONS.—
Span 10.40 m. (34 ft. 2 in.).
Length 7.42 m. (24 ft. 4 in.).
Height 2.48 m. (8 ft. 2 in.).
Width with wings folded 1.86 m. (6 ft. 1 in.).

WEIGHTS (Porsche engine).—
Weight empty 550 kg. (1,212 lb.).
Weight loaded (single-seat) 680 kg. (1,499 lb.).
Weight loaded (two seats) 760 kg. (1,675 lb.).
Max. loaded weight 880 kg. (1,940 lb.).

PERFORMANCE (Porsche engine).—
Max. speed 212 km.h. (132 m.p.h.).
Cruising speed 190 km.h. (118 m.p.h.).
Landing speed 75-85 km.h. (46.6-52.8 m.p.h.).
Rate of climb at S/L 180 m./min. (590 ft./min.).
Service ceiling 4,500 m. (14,770 ft.).



The RFB RW.3-A2 Multoplane.



The RFB RW.3-A3 Multoplane (65 h.p. Porsche 678/0 engine).

Take-off distance, fixed-pitch airscrew 270 m. (885 ft.).
Take-off distance, variable-pitch airscrew approx. 215 m. (710 ft.).
Normal range 1,000 km. (620 miles).
Max. range with tip-tanks 1,820 km. (1,130 miles).
Max. endurance 10.7 hours.

PERFORMANCE (Continental engine).—
Max. speed 235 km.h. (146 m.p.h.).
Cruising speed 216-227 km.h. (134-141 m.p.h.).
Rate of climb at S/L 240 m./min. (785 ft./min.).
Service ceiling 5,395 m. (17,700 ft.).
Take-off distance, fixed-pitch airscrew 220 m. (720 ft.).
Take-off distance, variable-pitch airscrew approx. 175 m. (575 ft.).
Normal range 680 km. (423 miles).
Max. range with tip-tanks 1,290 km. (802 miles).
Max. endurance 6 hours.

THE RFB RW.3-A2 MULTOPLANE.

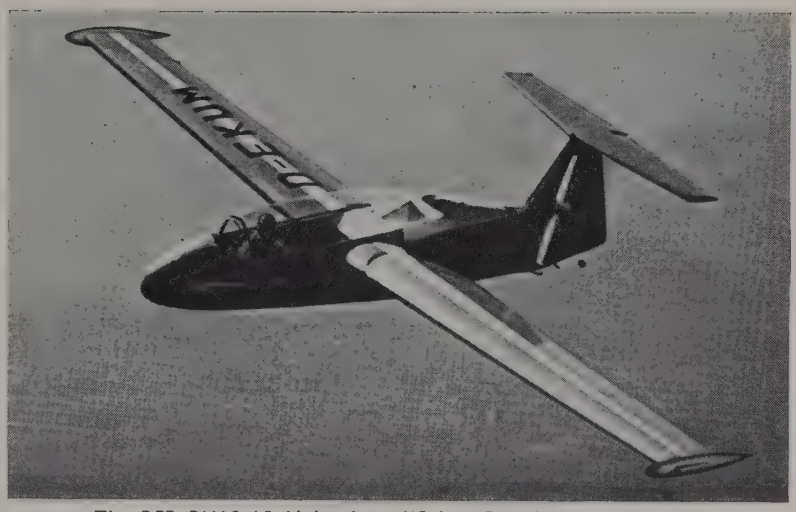
This is the power-assisted sailplane version of the RW.3. It is basically similar to the RW.3-A3, but is fitted with wing extensions to increase the span to 15.40 m. (50 ft. 6 in.). The ailerons on the -A3 become the landing flaps on the -A2.

WINGS.—Basically same as for RW.3-A3. Aspect ratio 12.5. Chord at tip 0.66 m. (2 ft. 2 in.). Total area of ailerons 1.32 m.² (14.2 sq. ft.). Total area of flaps 2.73 m.² (29.4 sq. ft.). Gross wing area 18 m.² (193.7 sq. ft.).

FUSELAGE, TAIL UNIT, LANDING GEAR, POWER PLANT AND ACCOMMODATION. – Same as for RW.3-A3, except auxiliary fuel tanks carried under wings.

DIMENSIONS.—
Span 15.40 m. (50 ft. 6 in.).
Length 7.42 m. (24 ft. 4 in.).
Height 2.48 m. (8 ft. 2 in.).

WEIGHTS AND LOADINGS—
Weight empty 580 kg. (1,278 lb.).
Weights loaded same as for RW.3-A3.



The RFB RW.3-A3 Multoplane (65 h.p. Porsche 678/0 engine).

PERFORMANCE (Porsche engine).—
Max. speed at S/L 200 km.h. (124 m.p.h.).
Cruising speed at S/L 180 km.h. (112 m.p.h.).
Landing speed 65-75 km.h. (40.4-46.6 m.p.h.).
Rate of climb at S/L 210 m./min. (690 ft./min.).
Service ceiling 5,500 m. (18,050 ft.).
Take-off run, fixed-pitch airscrew 240 m. (785 ft.).
Take-off run, variable-pitch airscrew approx. 190 m. (625 ft.).
Normal range 940 km. (585 miles).
Max. range with auxiliary tanks 1,705 km. (1,060 miles).
Max. endurance 10.7 hours.

PERFORMANCE (Continental engine).—
Max. speed 227 km.h. (141 m.p.h.).
Cruising speed 206-216 km.h. (128-134 m.p.h.).
Rate of climb at S/L 270 m./min. (885 ft./min.).
Service ceiling 6,400 m. (21,000 ft.).
Take-off distance, fixed-pitch airscrew, 195 m. (640 ft.).
Take-off distance, variable-pitch airscrew approx. 155 m. (510 ft.).
Normal range 640 km. (398 miles).
Max. range with auxiliary tanks 1,230 km. (765 miles).
Endurance 6 hours.

SCHEIBE

SCHEIBE-FLUGZEUGBAU G.m.b.H.

HEAD OFFICE AND WORKS: AUGUST-PFALTZ-STRASSE 23, DACHAU, NR. MUNICH.

Manager: Dipl.-Ing. Egon Scheibe.

Chief Designer: Dipl.-Ing. H. Hartmann.

Scheibe-Flugzeugbau G.m.b.H. was founded at the end of 1951 by Dipl.-Ing. Scheibe, who had previously built a prototype two-seat general purpose glider known as the Mü-13E Bergfalke in Austria. This aircraft flew for the first time on August 5, 1951, and was the first type produced in quantity by the newly-formed company.

The Mü-13E was followed by the Spatz, a mid-wing monoplane glider which made its first flight on March 12, 1952, and the single-seat L-Spatz with increased wing span. The prototype of the Specht two-seat training glider was completed in March, 1953, and has been developed into the side-by-side two-seat Sperber, which is now in production.

From the Mü-13E, the Bergfalke II two-seat glider with swept-forward wings was developed and this is still in production as the Bergfalke II/55. The Spatz was also developed further as the high-wing Spatz-55 and L-Spatz-55.

In addition, Scheibe built a single-seat high-performance contest sailplane with laminar-flow swept-forward wings, known as the Zugvogel-I, and Hanna Reitsch used an aircraft of this type to win the 1955 German gliding competitions. Later it was developed into the Zugvogel-II with unswept wings and the Zugvogel-III with increased span. The latest version is the Zugvogel-IV, which complies with the requirements of the new F.A.I. standard class. It flew for the first time in March, 1958.

All of these gliders have steel-tube fuselage construction.

After the construction of powered aircraft again became permissible in Germany, Scheibe began work on a small two-seat light aeroplane. Known as the Sperling, it made its first flight on August 8, 1955, and has since undergone considerable development.

From its foundation until March, 1958, Scheibe built a total of more than 330 aircraft of various types, in addition to many kits for home construction by amateurs. Gliders of Scheibe design have been built under licence by other companies and by gliding clubs.

THE SCHEIBE SF-23A SPERLING (SPARROW).

Since the prototype of the Sperling flew on August 8, 1955, it has undergone continuous development. In September, 1956, the original wing of Mü aerofoil section was replaced by a new wing of NACA section and somewhat larger area. The wooden tail unit was also replaced by a new unit of welded steel-tube construction.

In April, 1957, the original 65 h.p. Continental A65 engine was replaced by a 95 h.p. Continental C90 engine to provide adequate reserve power for towing heavy two-seat sailplanes and to meet German airworthiness requirements for a self-starter to be provided. This version, known as the SF-23A-C90, is now in production, but the Continental A65, the 85 h.p. Continental C85 or 65 h.p. Porsche engines are still offered as alternative power plants.

The first production Sperling was scheduled to fly in April, 1958.

TYPE.—Two-seat light monoplane.

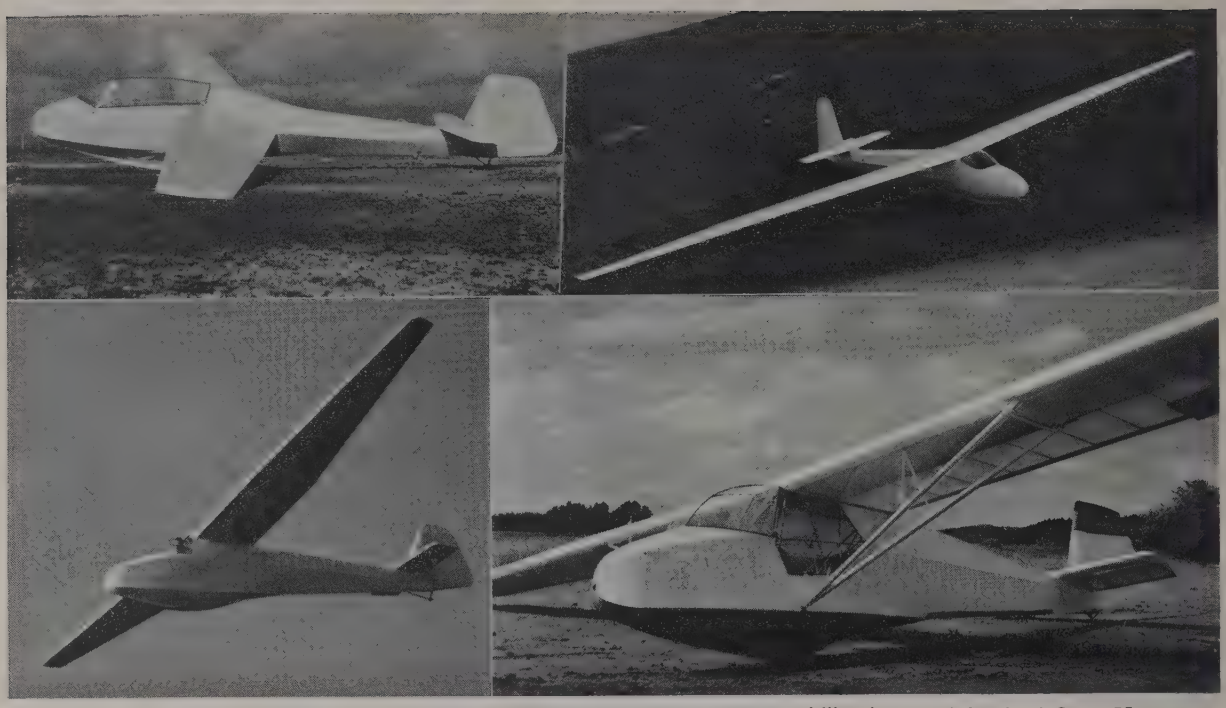
WINGS.—High-wing braced monoplane with quickly-removable wings. Wing section NACA 23012. Dihedral 1.5°. Incidence 2.5°. Chord 1.30 m. (51.2 in.) at root, 1.0 m. (39.4 in.) at tip. Aspect ratio 8. Wooden two-spar structure with plywood and fabric covering. Ailerons are counter-balanced and have plywood covering on their top surfaces. Streamline-section steel-tube bracing struts. No flaps. Total area of ailerons 1.09 m.² (11.72 sq. ft.). Wing area 12.16 m.² (130.9 sq. ft.).

FUSELAGE.—Steel-tube structure. Fabric-covered.

TAIL UNIT.—Braced monoplane type. Steel-tube structure with fabric covering. Fin integral with fuselage. Trim-tab in elevator. Areas: fin 0.80 m.² (8.61 sq. ft.), rudder 0.58 m.² (6.24 sq. ft.), tailplane 1.11



The Scheibe SF-23A Sperling (95 h.p. Continental C90 engine).



Scheibe Sailplanes. Top left, the Bergfalke II/55 ; top right, the Zugvogel-III ; bottom left, the L-Spatz-55 ; and bottom right, the Specht.

m.² (11.95 sq. ft.), elevators 0.76 m.² (8.18 sq. ft.).

LANDING GEAR.—Fixed tailwheel type. Rubber shock-absorbers. TOST main wheels 5.00 × 4. Brakes. Tail-wheel mounted on leaf spring and connected to rudder for ground manoeuvring.

POWER PLANT.—One 95 h.p. Continental C90-12F four-cylinder horizontally-opposed air-cooled engine, driving a Hoffman two-blade wooden fixed-pitch airscrew. Fuel tank in each wing-root. Total fuel capacity 80 litres (17.6 Imp. gallons). Oil capacity 4.73 litres (1.04 Imp. gallons).

ACCOMMODATION.—Two side-by-side seats in enclosed cabin, with entrance door on each side. Dual controls.

DIMENSIONS.—
Span 9.87 m. (32 ft. 4 in.).
Length 6.20 m. (20 ft. 4 in.).
Height 2.18 m. (7 ft. 2 in.).

WEIGHTS AND LOADINGS.—
Weight empty 420 kg. (926 lb.).
Weight loaded 660 kg. (1,455 lb.).
Wing loading 54 kg./m.² (11.06 lb./sq. ft.).
Power loading 7.3 kg./h.p. (16.09 lb./h.p.).

PERFORMANCE.—
Max. speed 200 km.h. (125 m.p.h.).
Max. diving speed 315 km.h. (196 m.p.h.).
Cruising speed 175 km.h. (109 m.p.h.).
Landing speed 75 km.h. (47 m.p.h.).
Ceiling 6,500 m. (21,325 ft.).
Time to 1,000 m. (3,280 ft.) 4 min.
Take-off distance 140 m. (460 ft.).
Landing distance 120 m. (395 ft.).
Range 700 km. (435 miles).
Endurance 4 hours.

THE SCHEIBE SPECHT (WOODPECKER).

The Specht is a tandem two-seat sailplane for dual instruction and solo training flights. It features the usual Scheibe construction with steel-tube fuselage and two-spar braced wooden wings of 14% Mü section. It has a mono-wheel landing gear and tail-skid.

The wings have an aspect ratio of 11, with a root chord of 1.35 m. (4 ft. 5 in.) and tip chord of 1.0 m. (3 ft. 3½ in.) and 2° of dihedral. Wing area is 16.64 m.² (179.1 sq. ft.).

DIMENSIONS.—
Span 13.50 m. (44 ft. 3½ in.).
Length 7.42 m. (24 ft. 4 in.).
Height 1.70 m. (5 ft. 7 in.).

WEIGHTS.—
Weight empty 210 kg. (463 lb.).
Weight loaded 390 kg. (860 lb.).

PERFORMANCE.—
Best glide ratio 20 : 1.
Min. sinking speed (two-seater) 0.87 m./sec. (2.85 ft./sec.).
Stalling speed 50 km.h. (31 m.p.h.).
Max. speed in still air 170 km.h. (106 m.p.h.).

THE SCHEIBE SPERBER (SPARROW-HAWK).

The Sperber is a development of the Specht sailplane and first flew on March 7, 1956. It is an enclosed side-by-side two-seat training glider of typical Scheibe construction, with steel-tube fuselage structure and braced wooden wings of 14% Mü section. It has a conventional mono-wheel landing gear and spring steel tail-skid.

The wings have an aspect ratio of 11.6 with a root chord of 1.35 m. (4 ft. 5 in.), tip chord of 0.94 m. (3 ft. 1 in.), and 2° of dihedral. Wing area is 17.40 m.² (187.3 sq. ft.).

DIMENSIONS.—
Span 14.20 m. (46 ft. 7 in.).
Length 7.4 m. (24 ft. 3 in.).
Height 1.40 m. (4 ft. 7 in.).

WEIGHTS.—
Weight empty 220 kg. (485 lb.).
Weight loaded 400 kg. (882 lb.).

PERFORMANCE.—
Best glide ratio 19 : 1.
Min. sinking speed (2 persons) 0.93 m./sec. (3.05 ft./sec.).
Stalling speed 48-54 km.h. (30-34 m.p.h.).
Max. speed in still air 170 km.h. (106 m.p.h.).

THE SCHEIBE BERGFALKE II/55.

Developed from the Mü 13E Bergfalke and the Bergfalke II, of which a total of more than 250 have been built, the Bergfalke II/55 is a tandem two-seat training and contest sailplane with swept-forward (4°) wings of 14.5% Mü section. It has a steel-tube fuselage and mono-wheel landing gear.

The single-spar wooden wings have an aspect ratio of 15.6, with a root chord of 1.51 m. (4 ft. 11 in.), tip chord of 0.65 m. (2 ft. 1½ in.) and 3.5° of dihedral. Wing area is 17.70 m.² (190.5 sq. ft.).

DIMENSIONS.—
Span 16.60 m. (54 ft. 6 in.).
Length 8.00 m. (26 ft. 3 in.).
Height 1.40 m. (4 ft. 7 in.).

WEIGHTS.—
Weight empty 250 kg. (551 lb.).
Weight loaded 440 kg. (970 lb.).

PERFORMANCE.—
Best glide ratio 28 : 1.
Min. sinking speed (2 persons) at 72 km.h. (44.7 m.p.h.) 0.72 m./sec. (2.36 ft./sec.).
Stalling speed 50-58 km.h. (31-36 m.p.h.).
Max. speed in still air 160 km.h. (99.5 m.p.h.).

THE SCHEIBE L-SPATZ-55 (SPARROW).

Developed from the Spatz-55, mainly by increasing the wing span to give a 10% improvement in performance, the L-Spatz-55 is a small lightweight single-seat sailplane suitable for training or competition flying. It has the usual Scheibe steel-tube fuselage and wooden single-spar wing structure. Aspect ratio is 19 and wing area 11.7 m.² (125.9 sq. ft.).

In a sailplane of this type, Baptist Hofmann set up a new German free distance record of 661 km. (411 miles) in May, 1957.

DIMENSIONS.—
Span 15.0 m. (49 ft. 3 in.).
Length 6.25 m. (20 ft. 6 in.).
Height 1.20 m. (3 ft. 11 in.).

WEIGHTS.—
Weight empty 155 kg. (342 lb.).
Weight loaded 265 kg. (584 lb.).

PERFORMANCE.—
Best glide ratio 29 : 1.
Min. sinking speed at 62 km.h. (38.5 m.p.h.). 0.64 m./sec. (2.01 ft./sec.).
Stalling speed 50 km.h. (31 m.p.h.).
Max. speed in still air 180 km.h. (112 m.p.h.).

THE SCHEIBE ZUGVOGEL-III.

The Zugvogel-III made its first flight in April, 1957. It was developed through the Zugvogel-II, which differed from the original Zugvogel design by introducing an unswept wing of simpler construction, a more simple control system and other innovations.

The Zugvogel-III differs from the Zugvogel-II only by having an increased wing span and larger fin and rudder. It has a fabric-covered steel-tube fuselage and wooden single-spar wing and tail structures. The wings have an NACA 63 series laminar-flow section. Aspect ratio of the wings is 20, with a root chord of 1.20 m. (3 ft. 11 in.) tip chord of 0.40 m. (1 ft. 4 in.) and 2.5° of dihedral. Wing area is 14.48 m.² (155.9 sq. ft.).

Jakob Laur flew a Zugvogel-III to victory in the 1957 German gliding contests.

DIMENSIONS.—
Span 17.0 m. (55 ft. 9 in.).
Length 7.10 m. (23 ft. 3½ in.).
Height 1.70 m. (5 ft. 7 in.).

WEIGHTS.—
Weight empty 245 kg. (540 lb.).
Weight loaded 365 kg. (805 lb.).

PERFORMANCE.—
Best glide ratio at 80 km.h. (50 m.p.h.). 35 : 1.

Min. sinking speed at 67 km.h. (41.6 m.p.h.) 0.58 m./sec. (1.90 ft./sec.).
Stalling speed 58 km.h. (36 m.p.h.).
Max. speed in still air 200 km.h. (124 m.p.h.).

THE SCHEIBE ZUGVOGEL-IV.

Latest development of the Zugvogel series of high-performance single-seat sailplanes is the Zugvogel-IV, which has been designed to meet the requirements of the F.A.I. standard class. It has the same type of construction as its predecessors, with cantilever high wing of NACA 63 series laminar-flow section, and is fitted with Schempp-Hirth air-brakes.

Its wing has a considerably shorter span than that of the Zugvogel-III. Aspect ratio is 16.8, with a root chord of 1.20 m. (3 ft. 11 in.), tip chord of 0.53 m. (1 ft. 9 in.) and 2.5° of dihedral. Wing area is 13.40 m.² (144.2 sq. ft.).

DIMENSIONS.—
Span 15.0 m. (49 ft. 3 in.).
Length 7.10 m. (23 ft. 3½ in.).
Height 1.58 m. (5 ft. 2 in.).

WEIGHTS AND LOADING.—
Weight empty 220 kg. (485 lb.).
Weight loaded 335 kg. (740 lb.).
Wing loading 25.0 kg./m.² (5.12 lb./sq. ft.).

PERFORMANCE (at 300 kg. = 660 lb. A.U.W.).—
Best glide ratio at 80 km.h. (50 m.p.h.) 31 : 1.
Min. sinking speed at 70 km.h. (43.5 m.p.h.) 0.65 m./sec. (2.13 ft./sec.).
Max. speed in still air 200 km.h. (124 m.p.h.).
Max. speed in gusty conditions 140 km.h. (87 m.p.h.).
Max. aircraft towing speed 140 km.h. (87 m.p.h.).
Max. winch launching speed 100 km.h. (62 m.p.h.).

WESERFLUG

"WESER" FLUGZEUGBAU G.m.b.H.

HEAD OFFICE: WERFTSTRASSE 158, BREMEN.

WORKS: LEMWERDER AND EINSWARDEN OLDENBURG.

Weserflug had its origin in a company formed in 1934 as a subsidiary of the A.G. "Weser" Bremen, one of the largest ship-building dock-yards in Germany. Pre-war, its development section was led by the late Dr. Rohrbach, the famous aircraft designer.

The company was reconstituted in 1956 as the Finanz-und Verwaltungs-Gesellschaft "Weser" m.b.H., but reverted to its former name as the "Weser" Flugzeugbau G.m.b.H. early in 1957. Of the ten plants that were operated in 1945, only those at Lemwerder and Einswarden could be restored to operation. They have a total area of more than 1,000,000 sq. ft., to which is added the works of the Motorenwerk Varel G.m.b.H., at Varel in Oldenburg, a subsidiary of Weserflug.

With Hamburger Flugzeugbau and Siebelwerke A.T.G., Weserflug is building under licence the French Nord 2501 Noratlas transport for the Federal German Air Force. To handle this important contract, the three companies have formed a group under the name of Flugzeugbau-Nord G.m.b.H. at Hamburg. Weserflug's share of the work involves production of the centre-section of the Noratlas, complete with engine installation, landing gear and tail-booms. This work is done at Einswarden.

Under contract to the Federal Minister of Defence, Weserflug is also assembling and test flying 26 Vertol H-21 helicopters at Einswarden, for the German Air Force. This follows an earlier contract to de-cocoon and test fly 558 Republic F-84F and RF-84F aircraft; and Weserflug is expected to be made responsible for inspection, modification and repair of these types.

Weserflug is licenced by Vertol Aircraft Corporation to operate as sales representative of that country in Germany and to repair and overhaul all Vertol helicopters stationed in Europe, with the exception of those in France. The two companies hope also to co-operate on future development work.

In addition, Weserflug is expanding considerably its development department with the object of producing its own designs, with particular emphasis on transport aircraft.

THE GERMAN DEMOCRATIC REPUBLIC

Development of a nationalised aircraft industry in East Germany (die Volkseigene Luftfahrtindustrie der Deutschen Demokratischen Republik) began in 1954 with a nucleus of experienced technicians, engineers and scientists. Its activities are controlled by the State through the :—

VEREINEGUNG VOLKSEIGENER BETRIESE FLUGZEUGBAU (Association of State-owned Aircraft Factories).

HEADQUARTERS: PIRNA/ELBE.
Director: Karl Patzold.
Deputy Director: Prof. Dipl.-Ing. Brunolf Baade.

The aircraft industry comprises experimental and production works for passenger-carrying aircraft, gliders, aero-engines and equipment, as well as a research centre.

PRINCIPAL AIRCRAFT PRODUCTION FACTORY: VEB FLUGZEUGBAU, DRESDEN.

RESEARCH ESTABLISHMENT: FORSCHUNGSZEUTRUM DER LUFTFAHRTINDUSTRIE (AIRCRAFT INDUSTRY RESEARCH CENTRE).
Director: Prof. Dipl.-Ing. Brunolf Baade.

Production is centred at present on a licence-built version of the Russian Ilyushin Il-14P transport and four types of glider, the Lehrmeister, Libelle, Meise and Grunau Baby IIb. Details of these aircraft and of the new nationally-designed Baade Type 152 four-jet airliner are given hereafter.

Details of aero-engine production in the German Democratic Republic will be found in the "Gas-Turbines" and "Piston-engines" section of this work.

THE BAADE TYPE 152.

The Type 152 is a four-jet passenger transport designed by Prof. Dipl.-Ing. Baade. The prototype was scheduled to make its first flight before the end of 1958, and production aircraft are expected to be available for delivery in 1960.

The prototype has tandem twin-wheel main landing gear units under its fuselage and wing-tip balancer wheels; but production aircraft, to which the following details apply, will have a conventional tricycle landing gear.

TYPE.—Four-jet medium-range transport.

WINGS.—High-wing cantilever monoplane. All-metal structure in three sections, comprising a centre-section and two outer wing panels carrying the engine nacelles, landing gear and wing-tip fuel tanks. Wing area 138 m.² (1,485 sq. ft.).

FUSELAGE.—All-metal monocoque structure, built in three portions.

TAIL UNIT. All-metal centilever monoplane structure.

LANDING GEAR.—Retractable tricycle type. Two four-wheel main bogies. Steerable twin nose-wheels. Track 13.10 m. (42 ft. 11½ in.). Wheelbase 7.38 m. (24 ft. 2½ in.).

POWER PLANTS.—Four Type 014 turbojets (each 3,150 kg. = 6,945 lb. s.t.) in pairs in nacelles carried on pylons under the wings. Fuel in 16 rubber bag-type tanks in the wings and two wing-tip tanks, with a total capacity of approx. 15,500 litres (3,410 Imp. gallons). Provision for additional wing tankage of 3,300 litres (726 Imp. gallons) capacity.

ACCOMMODATION.—Pressurised accommodation for a crew of four or five and 57 passengers in standard version. Alternative seating for 48 first class or 72 tourist class passengers. Seats are of the reclining type, with folding tables on the backs. Wardrobe, galley, two toilets, luggage and freight compartments.

DIMENSIONS.—
Span 26.4 m. (86 ft. 8 in.).
Length 31.3 m. (102 ft. 8 in.).
Height 9.70 m. (31 ft. 10 in.).

WEIGHTS.—
Weight empty, equipped 28,350-28,580 kg. (62,500-63,000 lb.).



The first prototype Baade Type 152 being wheeled out of the VEB Dresden factory.



Another view of the first prototype Baade Type 152 Jet Transport (four Type 014 turbojet engines).

Weight loaded 44,500-46,500 kg. (98,105-102,515 lb.).

PERFORMANCE (estimated).—
Max. speed at 4,800 m. (15,750 ft.) 920 km.h. (572 m.p.h.).
Cruising speed at 10,400-11,600 m. (34,120-38,050 ft.) 800 km.h. (497 m.p.h.)
Landing speed 200 km.h. (124 m.p.h.).
Take-off distance to 10.7 m. (35 ft.) 1,315 m. (4,315 ft.).
Take-off run 690 m, (2,265 ft.).
Normal range 2.500 km. (1,550 miles)

THE IL-14P.

The prototype of the German-built Il-14P flew in April, 1956, followed by the first production aircraft at the end of that year.

TYPE.—Twin-engined Transport.

WINGS.—Low-wing cantilever monoplane. Aspect ratio 10. T/c ratio 18% at root, 12% at tip. Mean chord 3.412 m. (11 ft. 2 in.). Dihedral 3° on centre-section, 3° 30′ on outer wings. Incidence 2°. All-metal three-spar structure in three portions, with outer wings bolted to centre-section. Fabric-covered ailerons and slotted flaps. Total area of ailerons 7.2 m.² (77.5 sq. ft.). Total area of flaps 15.79 m.² (170 sq. ft.). Hot-air de-icing. Wing area 100 m.² (1,076 sq. ft.).

FUSELAGE. — All - metal semi - monocoque structure.

TAIL UNIT.—Cantilever monoplane type. All-metal construction. Fin integral with fuselage. Rudder fabric-covered. Hot-air de-icing of fin and tailplane leading edges. Areas: vertical surfaces 12.6 m.² (135.6 sq. ft.), horizontal surfaces 21.32 m.² (229.5 sq. ft.). Tailplane span 9.25 m. (30 ft. 4 in.).

LANDING GEAR.—Retractable tricycle type. Hydraulic retraction. Single nose-wheel retracts rearward into fuselage. Main units, each with twin wheels, retract forward into engine nacelles. Main wheels 840 × 300 mm. Nose-wheel 770 × 330 mm. Brakes on main wheels. Wheel track 7.70 m. (25 ft. 3 in.). Wheelbase 5.37 m. (17 ft. 7½ in.).

POWER PLANT.—Two ASh-82T fourteen-cylinder radial air-cooled engines, developing 1,900 h.p. at 2,600 r.p.m. for take-off and with rated power of 1,530-1,630 h.p. at 2,400 r.p.m. at 1,600 m. (5,250 ft.). Four-blade A.W.50 metal constant-speed feathering airscrews, diameter 3.8 m. (12 ft. 6 in.). Engines built up as quickly-interchangeable complete power plants. Fuel in eight tanks in outer wings, with total capacity of 3,500 litres (770 Imp. gallons). Oil capacity 220 litres (48.4 Imp. gallons).

ACCOMMODATION.—Side-by-side seats for pilot and co-pilot on flight deck, with folding seat for flight engineer aft. Adjoining cabin for radio operator. Main cabin normally accommodates 26 passengers, but alternative 18-passenger and *de luxe* layouts also available. Galley and baggage compartment forward of main cabin. Wardrobes, baggage compartment and toilet to rear of main cabin. Rear starboard passenger door.

EQUIPMENT.—Three radio installations. Automatic pilot. Night and blind-flying equipment. De-icing and fire-extinguishing systems.

DIMENSIONS.—
Span 31.70 m. (104 ft.).
Length 21.31 m. (69 ft. 11 in.).
Height 7.90 m. (25 ft. 11 in.).

WEIGHTS (26-passenger version).—
Weight empty (equipped) 12,200 kg. (26,900 lb.).
Weight loaded 17,000 kg. (37,480 lb.).

PERFORMANCE.—
Max. speed 430 km.h. (267 m.p.h.).
Economical cruising speed 320 km.h. (199 m.p.h.).
Max. speed 370 km.h. (230 m.p.h.).
Service ceiling approx. 6,700 m. (22,000 ft.).
Single-engine ceiling (approx.) 2,300 m. (7,545 ft.).
Take-off run approx. 500 m. (1,640 ft.).
Take-off distance to 10.7 m. (35 ft.) approx. 750 m. (2,460 ft.).
Landing run approx. 430 m. (1,410 ft.).
Landing distance from 10.7 m. (35 ft.) approx. 630 m. (2,065 ft.).
Range with 26 passengers 1,500 km. (930 miles).
Range with 20 passengers 1,800 km. (1,120 miles).

THE LEHRMEISTER (INSTRUCTOR).

The Lehrmeister two-seat training and sporting glider was subjected to extensive flight and ground testing in 1956. Frequent flights of two to four hours as a two-seater and of over six hours as a single-seater were made. Structural tests showed that the airframe has a safety factor of 8.5. As a result of the success of the test programme, the Lehrmeister was put into quantity production in 1957.

TYPE.—Two-seat Training Glider.

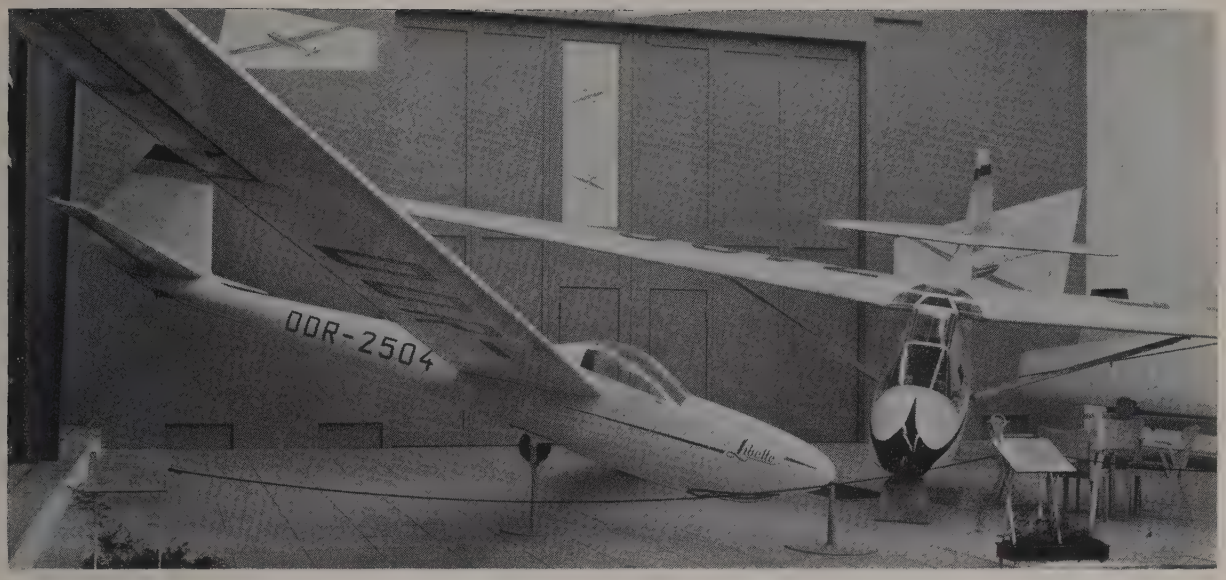
WINGS.—Braced high-wing monoplane. Wing section Gö 549 at root, Gö 676 at tip. Aspect ratio 15.2. Chord 1.80 m. (5 ft. 11 in.) at root, 0.45 m. (1 ft. 6 in.) at tip. Dihedral 2°. Single-spar wooden structure in two sections, with fabric covering. Wing-to-fuselage fixings can be disconnected by a single lever movement. Fabric-covered ailerons. Air brakes on under-surface linked with spoilers on top surface. Total area of ailerons 2.6 m.² (27.99 sq. ft.). Gross wing area 19 m.² (204.5 sq. ft.).

FUSELAGE. — Wood structure, plywood-covered.

TAIL UNIT.—Cantilever monoplane type. Wooden structure. Tailplane and fin plywood-covered. Elevator and rudder fabric-covered. Trim-tab in elevator. Fin integral with fuselage. Areas: horizontal surfaces 2.85 m.² (30.68 sq. ft.), vertical surfaces 1.46 m.² (15.71 sq. ft.).



The German-built IL-14P Airliner (two 1900 h.p. ASh-82T engines) as supplied to LOT (Polish Airlines).



On the *left*, the Libelle high-performance Sailplane and, on the *right*, the Lehrmeister Training Glider.

LANDING GEAR.—Rubber-sprung skid and sprung mono-wheel. Auxiliary tail-skid with tennis ball shock-absorption.
ACCOMMODATION.—Two seats in tandem under hinged and jettisonable Plexiglas canopy. Rear seat slightly raised to improve forward view. Rear control column removable for non-training flights.
DIMENSIONS.—
Span 17.00 m. (55 ft. 9 in.).
Length 7.95 m. (26 ft. 1 in.).
Height 2.12 m. (6 ft. 11 in.).
WEIGHTS.—
Weight equipped 300 kg. (661 lb.).
Weight loaded 500 kg. (1,100 lb.).
PERFORMANCE.—
Best glide ratio 24 : 1 at 85 km.h. (53 m.p.h.).
Min. sinking speed 0.85 m./sec. (2.79 ft./sec.) at 72 km.h. (45 m.p.h.).
Max. towing speed by winch or car 100 km.h. (62 m.p.h.).
Max. aero-tow speed 130 km.h. (81 m.p.h.).
Max. permissible diving speed 200 km.h. (124 m.p.h.).

THE LIBELLE.

The Libelle is a single-seat high-performance sailplane suitable for contest flying, advanced training and simple aerobatics. Flight trials began early in 1957 and simultaneous structural tests showed that the airframe has a safety factor of 10. The Libelle is in series production.

Assembly of all wing and fuselage components can be carried out without tools. Connection of the control rods is automatic when wings are assembled.

TYPE.—Single-seat High-performance Sailplane.
WINGS.—Cantilever mid-wing monoplane type. Gö 549 wing section. Aspect ratio 18.35. Chord 1.20 m. (3 ft. 11 in.) at root, 0.60 m. (1 ft. 11½ in.) at tip. Dihedral 3°. Single-spar wood structure in two parts, with plywood covering forward of spar and fabric covering aft. Fabric-covered slotted ailerons. Air brakes on under-surface linked with spoilers on top surface. Tanks in wings for water ballast which can be released in flight. Wing area 14.85 m.² (159.85 sq. ft.).
FUSELAGE.—Wood construction in two portions. Forward portion wood structure with plywood covering. Circular-section monocoque tail-boom.
TAIL UNIT.—Cantilever monoplane type. Wood frames with plywood-covered fixed surfaces and fabric-covered movable surfaces.
LANDING GEAR.—Retractable sprung mono-wheel with brake. Rubber-sprung fore and aft skids.
ACCOMMODATION.—Single seat under jettisonable canopy.
DIMENSIONS.—
Span 16.50 m. (54 ft. 2 in.).
Length 6.80 m. (22 ft. 3½ in.).
WEIGHTS AND LOADING.—
Weight equipped 240 kg. (529 lb.).
Weight loaded 330 kg. (728 lb.).
Wing loading 22.2 kg./m.² (4.55 lb./sq. ft.).
PERFORMANCE.—
Best glide ratio 30 : 1 at 80 km.h. (50 m.p.h.).
Min. sinking speed 0.70 m./sec. (2.30 ft./sec.) at 70 km.h. (43.5 m.p.h.).
Landing speed 57 km.h. (35.4 m.p.h.).
Max. towing speed by winch 100 km.h. (62 m.p.h.).
Max. aero-tow speed 130 km.h. (81 m.p.h.).
Max. permissible diving speed 240 km.h. (149 m.p.h.).

THE MEISE.

Of pre-war basic design, the Meise is a single-seat sailplane suitable for competition flying and training. It is capable of simple aerobatics. Series production was resumed in 1956.

TYPE.—Single-seat High-performance Sailplane.
WINGS.—Cantilever high-wing monoplane. Aspect ratio 15. Single-spar wooden structure in two parts. Fabric covered. Wing area 15 m.² (161.5 sq. ft.).
FUSELAGE.—All-wood structure.
TAIL UNIT.—Cantilever monoplane type. All-wood structure.
LANDING GEAR.—Rubber-sprung fore and aft skids.
ACCOMMODATION.—Single-seat under jettisonable transparent canopy.
DIMENSIONS.—
Span 15 m. (49 ft. 3 in.).
Length 7.27 m. (23 ft. 10 in.).
WEIGHTS.—
Weight empty 200 kg. (400 lb.).
Weight loaded 300 kg. (660 lb.).
PERFORMANCE.—
Best glide ratio 25 : 1 at 80 km.h. (50 m.p.h.).
Min. sinking speed 0.8 m./sec. (2.6 ft./sec.) at 68 km.h. (42 m.p.h.).
Max. towing speed by winch 80 km.h. (50 m.p.h.).
Max. aero-tow speed 100 km.h. (62 m.p.h.).
Max. permissible diving speed 200 km.h. (124 m.p.h.).

THE GRUNAU BABY IIB.

This is a modified version of the well-known pre-war Grunau Baby single-seat practice glider, of simplified construction. Series production was resumed in 1956.

TYPE.—Single-seat Practice Sailplane.
WINGS.—Strut-braced high-wing monoplane. Aspect ratio 13. Single-spar wooden structure in two parts. Fabric covering. Air brakes. Wing area 14.2 m.² (152.85 sq. ft.).
FUSELAGE.—Square-section wooden structure.
TAIL UNIT.—Monoplane type. Wood structure.
LANDING GEAR.—Sprung fore and aft skids.
ACCOMMODATION.—Single seat in open cockpit. Transparent canopy optional.
DIMENSIONS.—
Span 13.57 m. (44 ft. 6 in.).
Length 6.20 m. (20 ft. 4 in.).
WEIGHTS.—
Weight empty 165 kg. (364 lb.).
Weight loaded 250 kg. (550 lb.).
PERFORMANCE.—
Best glide ratio 17 : 1 at 60 km.h. (37 m.p.h.).
Min. sinking speed 0.90 m./sec. (2.95 ft./sec.) at 50 km.h. (31 m.p.h.).
Max. towing speed by winch 80 km.h. (50 m.p.h.).
Max. aero-tow speed 100 km.h. (62 m.p.h.).
Max. permissible diving speed 210 km.h. (130 m.p.h.).

THE KAPLICK-KERL.

The Kaplick-Kerl is being developed by the students of the Dresden Technical High School under the supervision of Professor Landmann.

It is a two-seat jet basic trainer of all-metal construction. The wings of NACA 651-412 laminar-flow aerofoil section, are provided with flaps inboard of ailerons and carry wing-tip fuel tanks. Leading-edge sweepback 13°, trailing-edge sweepback nil. The tail unit is of cantilever "T" type. The landing gear is of retractable tricycle type.

The enclosed cockpit seating two in tandem is equipped with light-weight ejection seats.

The power-plant consists of two jet units of unspecified make and thrust, mounted at the wing roots and partially buried in the sides of the fuselage.

DIMENSIONS.—
Span 10.7 m. (35 ft. 1⅛ in.).
Length 10.0 m. (32 ft. 10 in.).
Height 3.0 m. (9 ft. 10 in.).
DESIGN GROSS WEIGHT.—
3,000 kg. (6,613 lb.).
PERFORMANCE (estimated).—
Max. speed 750 km.h. (466 m.p.h.).
Endurance 1.5-2 hr.

THE BÖNISCH-VOGEL.

Another machine designed by the students of the Dresden Technical High School working under supervision of Professor Landmann is the Bönisch-Vogel single-seat glider-tug.

The Bönisch-Vogel is a cantilever low-wing monoplane of all-wood construction, is provided with cantilever "butterfly" Vee tail surfaces and a fixed tail-wheel type landing-gear, and is designed around a 125/145 h.p. in-line air-cooled engine. The wings, of NACA 23015 section, are equipped with flaps inboard of ailerons.

The aircraft is equipped with both a normal towing hook at the rear end of the fuselage and an unconventional Vee-type steel-tube towing hook attached to

the fuselage sides close to the c.g. Only a 10-metre (33 ft.) tow-rope will be used in connection with this latter hook, and a towed sailplane is expected to fly above the towing aircraft and "help" it to take-off and climb to a "release" altitude.

DIMENSIONS.—
Span 12.5 m. (41 ft.).
Length 7.6 m. (24 ft. 11 in.).
Height 2.96 m. (9 ft. 8½ in.).

PERFORMANCE (estimated).—
Best towing speed 100-115 km.h. (62-73 m.p.h.).
Landing speed 67.5 km.h. (42 m.p.h.).
Climb to 1,000 m. (3,280 ft.) 2 min. 38 sec.
Endurance 17 tows to 1,000 m. (3,280 ft.).

HUNGARY

When the war ended no aircraft manufacturing facilities remained in Hungary. The German armies dismantled and removed all plant and equipment when they evacuated the country.

In the early post-war years the Országos Magyar Repülö Egyesület (National Hungarian Aeronautical Association) played a part in the encouragement of the manufacture of light aircraft by, among other things, sponsoring design competitions. Among several light aircraft projects only a few reached prototype stage. The only powered aircraft of domestic origin to enter quantity production was the two/three-seat glider tug and sports high-wing braced monoplane, the Rubik R-18 Kánya I and II (Kite), respectively powered by the 160 h.p. Walter Minor 6-III in-line engine and the 160 h.p. M-11FR radial engine.

The most important constructional establishment was the Sportárutermelö N.V., or national concern for production of sporting equipment, which had an aircraft factory at Esztergom. This factory built, in addition to the R-18 Kánya, a number of very successful gliders to the design of Dipl. Ing. Ernö Rubik, the principal Rubik designs being the R-15 Koma (Friend) and R-16 Lepke (Butterfly) training gliders, the R-17 Moka (Joy) aerobatic sailplane and the R-22 Futár (Courier) high-performance sailplane.

Following the signing of the Warsaw Treaty, the Hungarian aircraft industry, in common with the aircraft industries of the other signatories, was placed under absolute Russian control, and aeroplanes of domestic origin then under development were abandoned. These included the SG-2 Kék Madár (Blue Bird) two-seat light monoplane designed by Samu and Geönczy; the Botond two-seat trainer designed by Nagy and Cserkuti; the Pajtás (Comrade) two-seat trainer/tourer designed by Lampich and the Lurko (Rogue) two-seat light monoplane designed by Burodics. Glider development, was less affected and several interesting models have appeared since this event, the best known being the M.30 Fergeteg (Thunderstorm) and the Junius 18 (June 18) high-performance sailplanes.

Later designs, recently in production and in widespread use in Hungarian gliding centres, include the Ifjusag, Super-Futar and Beke—descriptions of which follow hereafter.

THE IFJUSAG (YOUTH).

The Ifjusag two-seat training glider has been in production since 1953 and is widely used in Hungarian gliding centres. It has a composite structure. The cantilever wings are built of wood and have a single main spar and an oblique auxiliary spar carrying ailerons and flaps. The wings have a plywood-covered leading-edge and are covered with fabric on the remainder. They are fitted with air-brakes. The fuselage is built in two portions. The forward section is of welded steel tube, while the rear section is a semi-monocoque duralumin structure. The tandem seats are so arranged that the rear seat is over the C.G. and no ballast need be carried when the machine is flown as a single-seater. The landing gear consists of a single main wheel and small diameter nose-wheel.

DIMENSIONS.—
Span 15 m. (49 ft. 3 in.).
Length 7.5 m. (24 ft. 7½ in.).
Wing area 18.4 m.² (198 sq. ft.).

WEIGHT LOADED.—
455 kg. (1,003 lb.).

PERFORMANCE.—
Best glide ratio 20.6 : 1.
Min. sinking speed 1 m./sec. (3.28 ft./sec.).
Max. diving speed 200 km.h. (142 m.p.h.).

THE SUPER-FUTAR (SUPER-COURIER).

The Super-Futar single-seat high-performance sailplane is an improved version of the earlier Futar, which was the first Hungarian high-performance sailplane of the post-war era to enter quantity production. The aircraft is in widespread service with the Hungarian gliding centres, and a special variant, the Standard-Futar, was produced for the 15 m. class in the 1958 World Championships at Leszno. Two new versions, the Super-Futar C and D, are under construction, and prototypes will be tested in autumn.

Of all-wood construction, the Super-Futar has a mid-set cantilever single-spar wing covered with plywood. Two-part separately-controlled ailerons are fitted and there are air-brakes inboard of ailerons, but no flaps. Wing-tip end-plates are fitted. The fuselage is covered with plywood and the cockpit has a streamlined Plexiglas canopy. The semi-retractable monowheel landing-gear is carried between two telescopic shock-absorbers and is fitted with a brake.

DIMENSIONS (Super-Futar C).—
Span 15.7 m. (51 ft. 6 in.).
Length 6.4 m. (21 ft.).
Wing area 13 m.² (139.9 sq. ft.).

WEIGHT LOADED (Super-Futar C).—
300 kg. (661 lb.).

PERFORMANCE (Super-Futar C).—
Best glide ratio at 80 km.h. (50 m.p.h.) 28.2 : 1.
Min. sinking speed at 80 km.h. (50 m.p.h.) 0.77 m./sec. (2.53 ft./sec.).

THE Z-04 BÉKE (PEACE).

The Béke single-seat aerobatic sailplane was first flown in July, 1955, and was ordered into production later that year. The aircraft is intended for full normal and inverted aerobatics, and is built in comparatively small numbers. It has an all-wood structure. The mid-set cantilever wings have a single main spar and oblique auxiliary spar and are fitted with two-part ailerons and air-brakes, but no flaps. The fuselage is plywood-covered and the cockpit has one-piece moulded Perspex "bubble" canopy. The landing gear consist of a braked monowheel, front skid and tail bumper.

DIMENSIONS.—
Span 14 m. (45 ft. 11 in.).
Length 6.7 m. (22 ft.).
Wing area 13.7 m.² (147.5 sq. ft.).

WEIGHTS.—
Weight empty 215 kg. (474 lb.).
Weight loaded 300 kg. (661 lb.).

PERFORMANCE.—
Best glide ratio at 80 km.h. (50 m.p.h.) 23 : 1.
Min. sinking speed at 67 km.h. (42 m.p.h.) 0.88 m./sec. (2.89 ft./sec.).
Landing speed 55 km.h. (34 m.p.h.).
Max. diving speed 400 km.h. (248 m.p.h.).

THE A-08 SILARY (MEW).

A single-seat high-performance sailplane with laminar-flow wings, originally built specifically for the 1956 World Championships at St. Yan. Two improved examples known as Silary II, were produced for the 1958 World Championships at Leszno. The Silary II is provided with a parachute brake stowed in the rear fuselage end, and has fineness ratio of 32.

THE GYÖR 2.

A single-seat high performance sailplane of all-metal construction which has a fineness ratio of 33. No other details are available.

THE R-23 GEBICS (TUFTED LARK).

This is a single-seat experimental all-metal sailplane which was first flown in July, 1957. This aircraft is characterized by a very simple and light yet sturdy construction. The wings, of Gö 549 section, with widely-spaced ribs, are built up of sheet duralumin and covered aft of the spar with fabric. The Gebics is provided with fan-type air brakes, extending between the wing undersurfaces and the fuselage, which retract into the fuselage sides, and with a cantilever "butterfly" Vee tail. The Gebics was developed and built by the Alag Works. Span 13 m. (42 ft. 8 in.). Weight loaded 230 kg. (507 lb.). Fineness ratio 25.

THE R-15f KOMA.

This two-seat all-metal sailplane was flight-tested in the Spring of 1958. Retaining the general arrangement of the earlier R-15 Koma two-seat intermediate glider, which was used in Hungary since 1949, and superficially similar to this aircraft, the R-15f is constructed entirely of light metal, except for the rear portions of the wings, fin and elevators, which are metal-framed fabric-covered structures. The R-15f was built in the Sportárutermelö N.V. factory. Span 13.35 m. (43 ft. 10 in.). Weight empty 206 kg. (454 lb.).

THE MOTOR-PILIS.

In the field of powered aircraft the only design to appear in recent years is the Motor-Pilis powered glider, which was first flown in mid-1955. This is a modification of the Pilis single-seat advanced training sailplane, which was produced in substantial numbers in the early post-war years. The Motor-Pilis is equipped with the 25 h.p. Porsche engine, adapted from the Volkswagen automobile engine, installed above the wings and driving a two-blade pusher airscrew. Span 13.7 m. (45 ft.). Weight loaded 363 kg. (800 lb.). Max. speed 105 km.h. (57 m.p.h.). Range 350 km. (189 miles).

EXPERIMENTAL HELICOPTER.

Some years ago a two-seat light helicopter was designed by the students of the Budapest Politechnic, but because of the hostile altitude of the authorities towards the national designs, construction of the machine was abandoned. In 1957 the helicopter was revived and is being built in the Mechanical Workshops in Budapest. It is expected to fly before the end of 1958. The helicopter employs a single main rotor, based on Bell rotor principles, characterised by the rigid two-blade rotor and automatic stabilising bar. Estimated maximum speed 128 km.h. (69 m.p.h.). Estimated service ceiling 3,000 m. (9,842 ft.).

INDONESIA



The NU-225 Sikumbang (225 h.p. Continental O-470 engine).

ANGKATAN UDARA REPUBLIK INDONESIA, DEPOT PENJELIDIKAN, PERTJOBAAN DAN PEMBUATAN (Indonesian Air Force, Research, Development and Production Depot).

ADDRESS: HUSEIN SASTRANAGARA AIR FORCE BASE, BANDUNG.

Director: Major Nurtanio Pringgoadisurjo, B.Sc.(Ae.).

This technical unit of the Indonesian Air Force has facilities to design and manufacture gliders, light aircraft and other military equipment required for the Indonesian Air Force.

In 1953, this facility began the design of the NU-200 Sikumbang. The prototype made its first flight on August 1, 1954. The NU-200 has been described and illustrated in previous editions. An improved version known as the NU-225 has been built and was first flown on September 25, 1957.

During 1957, major modification work was started on a Piper L-4J with the object of converting it into a more suitable low-wing primary trainer. Known as the NU-85 Belalang (Grasshopper), the prototype conversion made its first flight on April 17, 1958.

Also during 1957, the design and construction of a very light aeroplane powered by a 25 h.p. Volkswagen engine was begun. This small aircraft is intended to be for the use of Aero Clubs in Indonesia.

At the beginning of 1958 major repairs on American, Czechoslovakian, Polish and German gliders which are in service with the Indonesian Air Force was also started.

THE NU-225 SIKUMBANG (BEE).

TYPE.—Single-seat light Ground Support monoplane.

WINGS.—Low-wing cantilever monoplane. Aerofoil section NACA 23015 at root, NACA 23009 at tip. Aspect ratio 6.6. Dihedral 5°. Incidence 4.5°. One-piece two-spar all-wood construction with plywood covering. Mechanically-operated all-wood plywood - covered landing flaps. Statically-balanced ailerons. Gross wing area 182 sq. ft. (16.9 m.²).

FUSELAGE.—Welded steel-tube structure with metal covering.

TAIL UNIT.—Cantilever all-wood plywood covered monoplane type. Fin mounted forward of tailplane. Trim-tabs in rudder and elevator. Areas: fin 9.9 sq. ft. (0.92 m.²), rudder 8.7 sq. ft. (0.80 m.²), tailplane 19.2 sq. ft. (1.78 m.²), elevators 16.8 sq. ft. (1.56 m.²). Span of tailplane 11 ft. 2½ in. (3.42 m.).

LANDING GEAR.—Retractable tricycle type. Cantilever oleo shock-absorber struts.

POWER PLANT.—One 225 h.p. Continental O-470-A six-cylinder horizontally-opposed air-cooled engine driving a Hartzell metal constant-speed airscrew. One fuel tank in each wing root and one tank in fuselage behind pilot's seat. Auxiliary fuel in wing-tip tanks.

ACCOMMODATION.—Single cockpit with sliding canopy.

DIMENSIONS.—
Span 34 ft. 9½ in. (10.61 m.).
Length 26 ft. 9 in. (8.16 m.).
Height 11 ft. (3.35 m.).

WEIGHTS AND PERFORMANCE.—
No data available.

THE NU-85 BELALANG (GRASSHOPPER).

The NU-85 is a low-wing modification of the Piper Cub L-4J which is still in service in the Indonesian Air Force as a primary trainer. The prototype NU-85 made its first flight on April 17, 1958. If the Belalang proves to be a better military trainer than the L-4J, a major modification programme to convert all L-4J's in service will be undertaken.



The NU-225 Sikumbang (225 h.p. Continental O-470 engine).

TYPE.—Two-seat Primary Trainer.

WINGS.—Low-wing rigidly-braced monoplane. USA-35B wing section. Aspect ratio 6. Chord 5.1 ft. (1.5 m.) constant. Dihedral 5°. Incidence 1° 37′ at root. Spruce spars, aluminium-alloy ribs, fabric covering. Vee bracing struts from top fuselage longerons. Ailerons and flaps have aluminium-alloy frames, fabric covering. Total area of flaps 8.86 sq. ft. (0.82 m.²). Total aileron area 11.5 sq. ft. (1.068 m.²). Gross wing area 156 sq. ft. (14.49 m.²).

FUSELAGE.—Welded steel tube framework covered with fabric.

TAIL UNIT.—Braced monoplane type. Welded steel tube frames, covered with fabric. Areas: fin 4.02 sq. ft. (0.37 m.²), rudder 6.55 sq. ft. (0.608 m.²), tailplane 14.65 sq. ft. (1.36 m.²), elevators 10.65 sq. ft. (0.99 m.²). Span of tail 10 ft. (3.05 m.).

LANDING GEAR.—Fixed tail-wheel type. Piper L-4 shock-absorbers. Hayes wheels with Goodrich tyres. Hydraulic expander tube brakes. Leaf-spring steerable tail-wheel. Track 5 ft. 11 in. (1.8 m.).

POWER PLANT.—One 85 h.p. Continental C85-12 four-cylinder horizontally-opposed air-cooled engine. Sensenich two-blade fixed-pitch wood airscrew, 6 ft. (1.83 m.) diameter. Fuel tank (10 U.S. gallons = 60 litres) in fuselage aft of firewall.



The prototype NU-85 Belalang (85 h.p. Contintental C85 engine).

Accommodation.—Tandem seats under continuous transparent canopy. Complete dual controls and instruments with military seats. Canopy hinged to open to right side to give access to both seats from left wing root.

Dimensions.—
Span 30 ft. 7 in. (9.3 m.).
Length 22 ft. (6.7 m.).
Height 6 ft. 8 in. (2.03 m.).

Weights.—
Weight empty 935 lb. (424 kg.).
Disposable load 440 lb. (200 kg.).
Weight loaded 1,375 lb. (624 kg.).

Performance.
Max. speed 115 m.p.h. (184 km.h.).
Cruising speed 90 m.p.h. (144 km.h.).
Landing speed 45 m.p.h. (72 km.h.).
Rate of climb at S/L 600 ft./min. (183 m./min.).
Service ceiling 12,000 ft. (3,660 m.).
Absolute ceiling 14,000 ft. (4,270 m.).
Cruising range 350 miles (560 km.).
Take-off run 500 ft. (152 m.).
Landing run 400 ft. (122 m.).



The prototype NU-85 Belalang (85 h.p. Continental C85 engine).

THE NU-25 KUNANG (FIREFLY).

Type.—Single-seat light monoplane.

Wings.—Cantilever monoplane. NACA 2412 wing section. Aspect ratio 7. Chord 3 ft. 7.3 in. (1.09 m.) constant. Dihedral 5°. Incidence 3° at root, 0° at tip. Tapered wing with fixed slots. Wood box spars and girder ribs, fabric covering. Ailerons are wood-framed and fabric-covered. Total aileron area 3.25 sq. ft. (0.30 m.²). Gross wing area 72.9 sq. ft. (6.7 m.²).

Fuselage.—Spruce and plywood framework, fabric covering.



The NU-25 Kunang (25 h.p. Volkswagen engine).

Tail Unit.—Wire-braced monoplane type with sweptback vertical surfaces. Wood frames, fabric covering. Areas: fin 3.23 sq. ft. (0.30 m.²), rudder 3.23 sq. ft. (0.30 m.²), tailplane 5.81 sq. ft. (0.54 m.²), elevators 3.88 sq. ft. (0.36 m.²). Span of tailplane 6 ft. 2¾ in. (1.90 m.).

Landing Gear.—Fixed tail-wheel type. Auster Mk. III type shock-absorbers. Royal Airplane wheels and low-pressure tyres. Hydraulic expander tube brakes. Leaf-spring steerable tail-wheel. Track 4 ft. 1 in. (1.25 m.).

Power Plant.—One 25 h.p. Volkswagen flat-four air-cooled engine. Two-blade fixed-pitch airscrew 4 ft. 8¾ in. (1.4 m.) diameter. Fuel tank (4 U.S. gallons = 15 litres) in fuselage immediately aft of firewall.

Accommodation.—Single seat beneath sliding canopy. Baggage compartment behind seat accessible from inside.

Dimensions.—
Span 22 ft. 11 in. (6.98 m.).
Height 5 ft. 10 m. (1.77 m.).

Weights (designed).—
Weight empty 352 lb. (160 kg.).
Disposable load 220 lb. (100 kg.).
Weight loaded 572 lb. (260 kg.).

Performance (estimated).—
Cruising speed 80 m.p.h. (128 km.h.).
Landing speed 45 m..p.h. (72 km.h.).

ITALY

AERFER

INDUSTRIE MECCANICHE AERONAUTICHE MERIDIONALI-AERFER.

HEAD OFFICE: 30, CORSO MALTA, NAPLES.

WORKS: POMIGLIANO D'ARCO; CAPODICHINO AIRPORT, NAPLES; AND NAPLES VASTO.

General Manager and Managing Director: Dr. Ing. Amedeo Carassai.

Formed in 1955, the Industrie Meccaniche Aeronautiche Meridionali-Aerfer comprises factories which formerly belonged to Officine di Pomigliano per Costruzioni Aeronautiche e Ferroviarie Aerfer, founded in 1949, and to Industrie Meccaniche ed Aeronautiche Meridionali, builders of the wartime RO-37, RO-41 and RO-57 aircraft.

Aerfer is engaged on the production, overhaul and reconditioning of both jet and piston-engined aircraft. It is manufacturing spare parts for the Republic F-84G and F-84F under licence; and is developing the Sagittario 2 and Ariete light fighters designed by Ing. Sergio Stefanutti.

A later project, in the initial design stage, is the Aerfer Leone (Lion) mixed-power interceptor, with a de Havilland Gyron Junior turbojet and de Havilland Spectre rocket-engine.

THE AERFER ARIETE (BATTERING RAM).

The Ariete lightweight fighter is a development of the Sagittario 2, from which it differs by the addition of a Rolls-Royce Soar RS.2 auxiliary turbojet for improved take-off, climb and combat performance. The Soar is mounted in the tail of the fuselage, with its retractable air intake above the rear fuselage. Its installation necessitates no modifications to the main engine installation, which remains exactly as in the Sagittario 2.

Main advantage of this tandem-turbojet installation is that the Soar offers a considerable increase in power for brief periods at a very small increase in empty weight. It also runs on the same fuel as the main Derwent turbojet.

The Ariete has been designed to operate from grass fields and short airstrips, and is suitable for use as an interceptor or tactical fighter. The prototype flew for the first time on March 27, 1958.

DIMENSIONS.—
Span 7.50 m. (24 ft. 7 in.).
Length 9.60 m. (31 ft. 6 in.).

WEIGHT.—
Weight empty 2,400 kg. (5,291 lb.).



The Aerfer Sagittario 2 (Rolls-Royce Derwent turbojet engine).

PERFORMANCE.—
Max. speed Mach 1.1.
Time to 12,000 m. (39,370 ft.) 4 min. 20 sec.
Take-off distance 500 m. (1,640 ft.).
Landing distance 900 m. (2,950 ft.).

THE AERFER SAGITTARIO (ARCHER) 2.

The Sagittario 2 is an all-metal development of the Sagittario 1 research aircraft, which was built by the Ambrosini company and was described in the 1954-55 edition of "All the World's Aircraft."

Designed for both tactical support and interception duties, the Sagittario 2 made its first flight in June, 1956 and later reached a speed of Mach 1.1 during a dive from 13,700 m. (45,000 ft.) although it is powered with a Rolls-Royce Derwent 9 turbojet engine of only 1,633 kg. (3,600 lb.) s.t. From it is being developed the Aerfer Ariete lightweight fighter.

TYPE.—Single-seat Tactical Support and Day Interceptor Fighter.

WINGS.—Mid-wing cantilever monoplane. Aspect ratio 3.82. Sweepback 41° at ¼-chord line. All-metal stressed skin structure. Statically and dynamically balanced slotted ailerons operated through Fairey hydraulic powered controls with manual reversion. All-metal plain flaps, hydraulically operated. Gross wing area 14.73 m.² (158.55 sq. ft.).

FUSELAGE.—All-metal structure in two quickly detachable sections. Underside covered with an air-cooled sheet of stainless steel to prevent damage by exhaust efflux. Fin integral with fuselage. Two hydraulically operated and mechanically interconnected air brakes on sides of rear fuselage.

TAIL UNIT.—All-metal structure with one-piece hydraulically operated variable incidence "flying" tailplane.

LANDING GEAR.—Retractable tricycle type. Dowty liquid spring shock absorbers. Hydraulic retraction. Dunlop wheels and brakes.

POWER PLANT.—One Rolls-Royce Derwent 9 turbojet engine (1,633 kg.=3,600 lb. s.t.) mounted in fuselage nose, with jet-pipe carried down to exhaust under fuselage. Fuel in four rubber tanks in fuselage with total capacity of 1,200 litres (264 Imp. gallons).

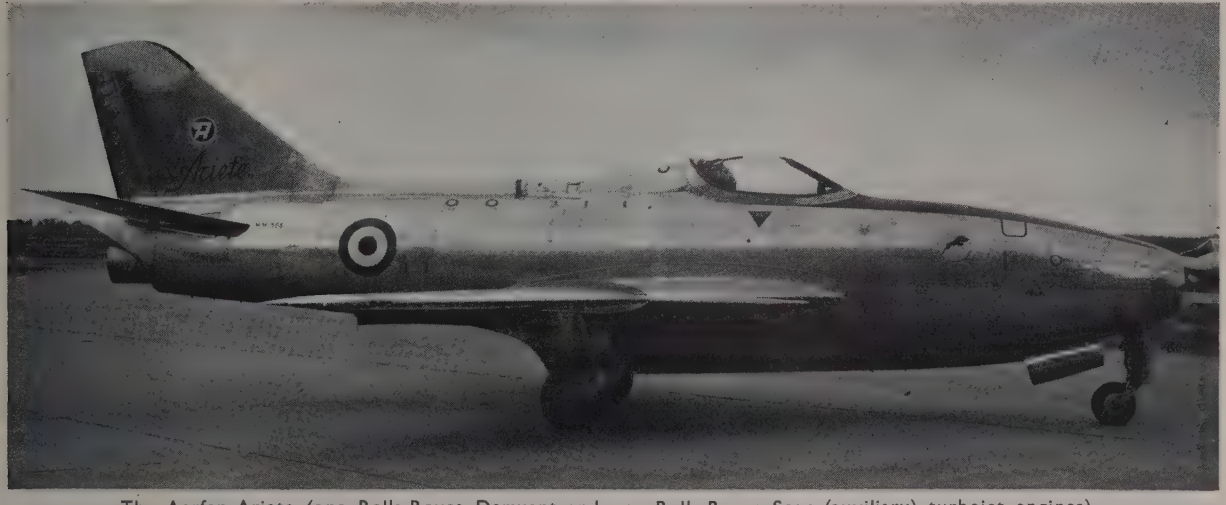
ACCOMMODATION.—Single seat in pressurised cockpit with jettisonable canopy. Martin-Baker Mk. 4 lightweight fully-automatic ejector seat. Air-conditioning and pressure-breathing oxygen systems. Manually-opened canopy.

ARMAMENT.—Two 30 mm. guns in fuselage. Provision for carrying 2×225 kg. (500 lb.) bombs, 2×315 kg. (700 lb.) napalm tanks, two additional guns or 12×7.62 cm. (3 in.) rockets under wings.

DIMENSIONS.—
Span 7.50 m. (24 ft. 7 in.).
Length 9.50 m. (31 ft. 2 in.).
Height 2.02 m. (6 ft. 8 in.).

WEIGHT AND LOADINGS.—
Weight loaded 3,293 kg. (7,260 lb.).
Wing loading 227 kg./m.² (46.5 lb./sq. ft.).
Power loading 0.91 kg./h.p. (2.02 lb./h.p.).

PERFORMANCE.—
Max. speed 1,006 km.h. (625 m.p.h.).
Rate of climb at S/L. 2,530 m./min. (8,300 ft./min.).
Time to 12,000 m. (39,370 ft.) 10 min.
Service ceiling 14,000 m. (46,000 ft.).
Take-off distance 450 m. (1,470 ft.).
Landing distance 500 m. (1,640 ft.).



The Aerfer Ariete (one Rolls-Royce Derwent and one Rolls-Royce Soar (auxiliary) turbojet engines).

AGUSTA



The Agusta AZ8-L Transport (four 540 h.p. Alvis Leonides engines).

COSTRUZIONI AERONAUTICHE GIOVANNI AGUSTA.

HEAD OFFICE : CASCINA COSTA, GALLARATE.

President and General Manager : Comm. Domenico Agusta.

Deputy General Manager : Dr. Mario Agusta.

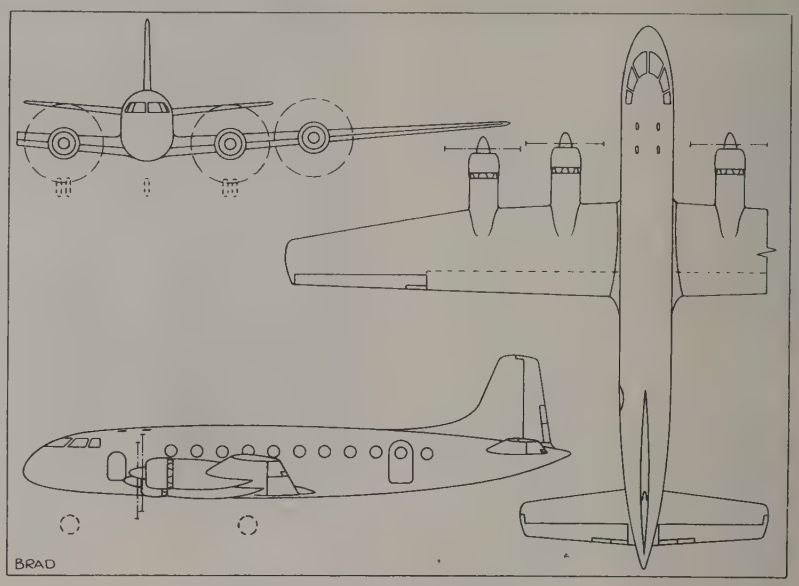
Chief Designer : Dr. Filippo Zappata.

This company was established in 1923 by Giovanni Agusta. It built numerous experimental and production aircraft before the war and, despite post-war difficulties, has succeeded in re-establishing itself in the aircraft manufacturing field.

In 1952 Agusta obtained the exclusive manufacturing rights in Europe for the Bell Model 47 helicopter and the first Agusta-built Model 47G made its maiden flight on May 22, 1954. The company is also producing the Model 47J in quantity for sales throughout Europe.

Agusta is now developing helicopters of its own design and at the time of writing prototypes of the Models 101D and 102, brief details of which follow, were in an advanced stage of construction.

Dr. Filippo Zappata has prepared for Agusta various designs for transport aircraft for both civil and military purposes, and the Italian Air Ministry awarded the company a contract to build a prototype of the 22/26-seat Agusta Model AZ8-L civil transport. This aircraft flew for the first time on June 9, 1958.



The Agusta AZ8-L Transport.

THE AGUSTA AZ8-L.

TYPE.—Four-engined Medium-range Transport.

WINGS.—Low-wing cantilever monoplane. Aerofoil section Z.3. Aspect ratio 9.76. Chord 3.22 m. (10 ft. 7 in.) at root, 1.64 m. (5 ft. 5 in.) at tip. Dihedral 8½°. Incidence 3°. Single-spar all-metal stressed-skin structure. Frise-type ailerons. Slotted flaps. Total area of ailerons 8.20 m.² (88.26 sq. ft.). Total area of flaps 11.20 m.² (120.56 sq. ft.). Gross wing area 66.80 m.² (719 sq. ft.).

FUSELAGE.—All-metal monocoque structure.

TAIL UNIT.—Cantilever monoplane type. All-metal structure, including covering of movable surfaces. Fin area 4.10 m.² (44.12 sq. ft.), rudder area 2.30 m.² (24.75 sq. ft.), tailplane area 7.0 m.² (75.32 sq. ft.), elevator area 4.10 m.² (44.12 sq. ft.). Tailplane span 8.72 m. (28 ft. 7 in.).

LANDING GEAR.—Retractable tricycle type. Each main unit has twin wheels and single shock strut. Steerable nose unit has single wheel. Hydraulic retraction. Dual hydraulic brakes on each main wheel. Track 5.80 m. (19 ft.). Wheelbase 6.55 m. (21 ft. 5¾ in.).

POWER PLANT.—Four Alvis Leonides Mk. 22 (503/2) nine-cylinder radial air-cooled engines, each developing 470 h.p. at maximum continuous cruise and with 540 h.p. available for take-off. D.H. three-blade constant-speed feathering airscrews, 9 ft. (2.74 m.) diameter. All fuel tanks in wings. Normal fuel capacity 3,200 litres (700 Imp. gal.). One 45 litre (10 Imp. gal.) oil tank in each nacelle.

ACCOMMODATION.—Crew of two, consisting of pilot and co-pilot/radio operator. Dual controls. Cabin, which is sound-proofed, air-conditioned and heated, accommodates 22 first-class or 26 tourist passengers. Cabin interior is 13.5 m. (44 ft. 3 in.) long with 1.65 m. (5 ft. 5 in.) maximum width and 1.90 m. (6 ft. 3 in.) maximum height. Forward baggage compartment has volume of 2.10 m.³ (74 cub. ft.), aft baggage compartment a volume of 3.40 m.³ (120 cub. ft.).

DIMENSIONS.—
Span 25.50 m. (83 ft. 8 in.).
Length 19.44 m. (63 ft. 9 in.).
Height 6.60 m. (21 ft. 8 in.).

WEIGHTS.—
Equipped weight, including crew, fuel, etc. 7,620 kg. (16,800 lb.).
Payload 2,835 kg. (6,250 lb.).
Max. loaded weight 11,300 kg. (24,900 lb.).
Max. landing weight 10,800 kg. (23,800 lb.).
Max. zero-fuel weight 10,300 kg. (22,700 lb.).

PERFORMANCE (Estimated, at loaded weight of 10,600 kg. = 23,370 lb.).—
Cruising speed, max. cont. power at 3,000 m. (9,850 ft.) 405 km.h. (252 m.p.h.).
Cruising speed, recommended power at 3,000 m. (9,850 ft.) 370 km.h. (230 m.p.h.).
Max. rate of climb at S/L. flaps up 300 m./min. (985 ft./min.).
Ceiling 7,500 m. (24,600 ft.).
Take-off distance to 15.25 m. (50 ft.) at S/L. 590 m. (1,935 ft.).
Landing distance from 50 ft. (15.25 m.) 840 m. (2,750 ft.).
Max. range, with 1,470 kg. (3,240 lb.) payload and reserves, 2,500 km. (1,555 miles).
Range with max. payload, no reserves, 650 km. (400 miles).



The Agusta-Bell Model 47G Helicopter.

THE AGUSTA-BELL MODEL 47.

Agusta is building under licence the Bell Model 47G helicopter with the Franklin 6V4-200-C22 engine; the Model 47G-2 with the Lycoming V0-435-A1B engine, derated to 200 h.p. and with hydraulically-boosted controls; and the Model 47J with the Lycoming V0-435 engine derated to 220 h.p. and with hydraulic boost control and aerodynamic streamlining.

General structural details and dimensions of all these models will be found under "Bell" (U.S.A.).

Agusta is also building two versions of the 47J which incorporate modifications of their own design. One is fitted with dual controls and the other has accommodation for pilot and four passengers.

The weight and performance data of the Agusta-Bell 47J are as follows :—

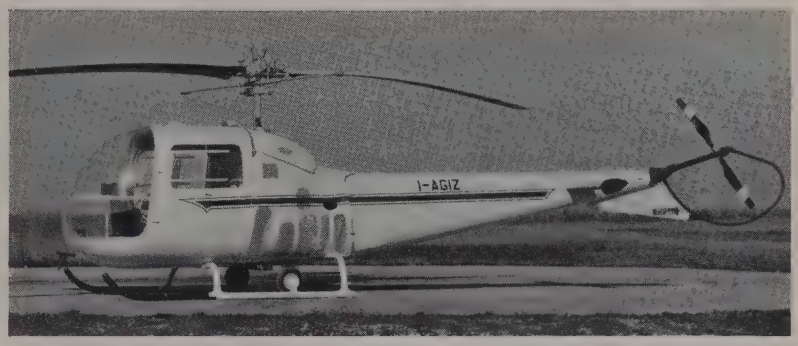
WEIGHTS (Standard model).—
Weight empty 697.6 kg. (1,538 lb.).
Weight loaded 1,163.5 kg. (2,565 lb.).
WEIGHTS (4-passenger version).—
Weight empty 735 kg. (1,620 lb.).
Weight loaded 1,270 kg. (2,800 lb.).
PERFORMANCE (at 1,163.5 kg.=2,565 lb. A.U.W.).—
Max. allowable speed 169 km.h. (105 m.p.h.).
Cruising speed 140 km.h. (87 m.p.h.).
Max. rate of climb at S/L. 216 m./min. (710 ft./min.).
Time to 1,525 m. (5,000 ft.) 6 min. 18 sec.
Service ceiling 3,978 m. (13,050 ft.).
Absolute ceiling 4,420 m. (14,500 ft.).
Hovering ceiling in ground effect 2,240 m. (7,350 ft.).
Range 309 km. (192 miles).
Endurance 2 hr. 37 min.
PERFORMANCE (4-passenger version at 1,270 kg.=2,800 lb. A.U.W.).—
Max. allowable speed 169 km.h. (105 m.p.h.).
Cruising speed 140 km.h. (87 m.p.h.).
Max. rate of climb at S/L 192 m./min. (630 ft./min.).
Range 380 km. (236 miles).
Endurance 2 hr. 45 min.
NOTE: Weight and performance data for 47J with dual controls are the same as for the standard model.

THE AGUSTA-BELL MODEL 102.

The Model 102 is a general utility helicopter which has been designed to meet the diverse requirements of both civil and military operations. It makes use of the Bell-type rotor system and is powered by a 600 h.p. Pratt & Whitney R-1340 engine.

The Model 102 will have accommodation for nine persons (including pilot), or four stretcher patients plus medical attendant, or a combination of passengers and freight.

DIMENSIONS.—
Overall length 17.92 m. (58 ft. 9 in.).
Length of fuselage 12.73 m. (41 ft. 9 in.).
Max. width 2.71 m. (8 ft. 10 in.).
Max. height 3.23 m. (10 ft. 7 in.).



The Agusta-Bell Model 47J Helicopter.

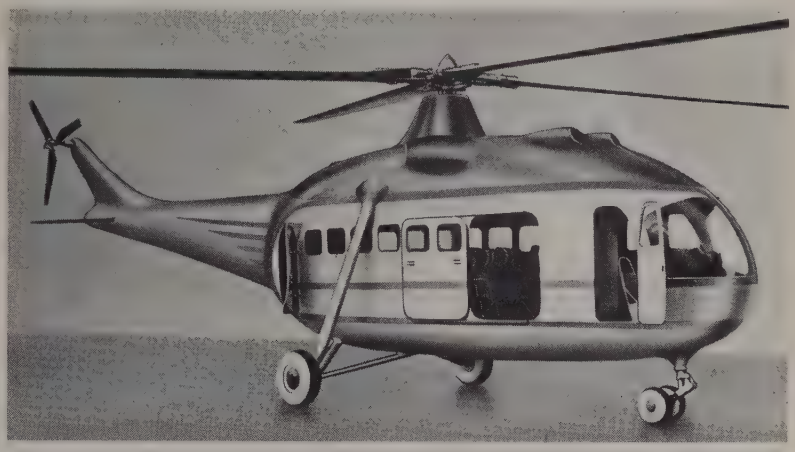
WEIGHTS (designed).—
Weight empty 1,857 kg. (4,095 lb.).
Weight loaded 2,820 kg. (6,217 lb.).
PERFORMANCE (estimated).—
Max. speed at S/L 192 km.h. (120 m.p.h.).
Cruising speed at 600 ft. (1,830 m.) for best range 160 km.h. (100 m.p.h.).
Hovering ceiling in ground effect 2,810 m. (9,200 ft.).
Service ceiling 4,270 m. (14,000 ft.).
Range at gross A.U.W., standard air at sea level, with no wind and no reserves 460 km. (296 miles).
Max. endurance 3 hr. 20 min.

THE AGUSTA AZ101D HELICOPTER.

The AZ 101D is a medium-weight helicopter which will be powered by three 750 e.s.h.p. Turbomeca Turmo III gas-turbine engines. It has been designed for both military and commercial use and has accommodation for up to 27 persons.

No further details are available but its general layout can be gathered from the accompanying illustration.

DIMENSIONS.—
Max. length (with rotor) 19.5 m. (63 ft. 4 in.).
Max. height 4.7 m. (15 ft. 5 in.).
Main rotor dia. 19.0 m. (62 ft. 3 in.).
Tail rotor dia. 3.2 m. (10 ft. 4 in.).
WEIGHTS (designed).—
Weight empty 4,550 kg. (10,000 lb.).
Max. disposable load 3,200 kg. (7,130 lb.).
Weight loaded 7,750 kg. (17,130 lb.).
PERFORMANCE (estimated).—
Max. speed at max. continuous power at 300 m. (915 ft.) 225 km.h. (140 m.p.h.).
Cruising speed for max. range 205 km.h. (127 m.p.h.).
Rate of climb at max. continuous power 350 m./min. (1,140 ft./min.).
Hovering ceiling at max. continuous power, out of ground effect 1,500 m. (4,950 ft.).
Hovering ceiling, in ground effect 3,100 m. (10,100 ft.).
Service ceiling at max. continuous power 5,500 m. (18,000 ft.).



A model of the Agusta AZ101D Helicopter.

AMBROSINI

SOCIETA' AERONAUTICA ITALIANA, ING. A. AMBROSINI & C.

REGISTERED OFFICE: VIA PALESTRO 68, ROME.

HEAD OFFICE: VIALE MAINO 23, MILAN.

AIRCRAFT WORKS: PASSIGNANO SUL TRASIMENO (PERUGIA).

AERODROME: CASTIGLION DEL LAGO.

Chairman and Managing Director: Ing. Angelo Ambrosini.

The Societa Aeronautica Italiana was incorporated into the Ambrosini group in 1934. Since that time a long series of touring and training aircraft have been designed and built.

The company's first post-war types were the S.1001 Grifo four-seat touring and training monoplane, and a two-seat primary trainer development of the Grifo known as the S.1002 Trasimenus.

They were followed by the Ambrosini S.7 military trainer and the slightly larger and more powerful Super S.7, both of which were produced in small series for the Italian Air Force.

The last aircraft produced by Ambrosini was the F.7 Rondone three/four seat light monoplane, of which a series of ten was laid down. Only a few were completed.

All of these aircraft have been fully described and illustrated in previous editions of "All the World's Aircraft."

AVIAMILANO

AVIAMILANO COSTRUZIONI AERONAUTICHE.

HEAD OFFICE: VIA MACEDONIO MELLONI, 70, MILAN.

Managing Director: Ing. Mario Vietri.

Chief Designer: Ing. Stelio Frati.

A new version of the Falco F.8 two-seat cabin monoplane, built by Aviamilano to the design of Stelio Frati, made its first flight on April 25, 1956 and is in series production.

Aviamilano has also built the prototype of a new four-seat cabin monoplane known as the Nibbio F. 14, which flew for the first time on January 16, 1958.

THE AVIAMILANO NIBBIO F.14.

TYPE.—Four-seat Cabin monoplane.

WINGS.—Cantilever low-wing monoplane. NACA 64000 series (modified) wing section. Aspect ratio 7. Chord 1.78 m. (5 ft. 10 in.) at root, 0.82 m. (2 ft. 8¼ in.) at tip. Dihedral 4°. All-wood one-piece single-spar structure, covered with plywood and with fabric overall. Ailerons and electrically-operated split flaps of wood construction with plywood covering and fabric overall. Total area of ailerons 1.06 m.² (11.41 sq. ft.). Total area of flaps 1.51 m.² (16.25 sq. ft.). Gross wing area 12.90 m.² (138.9 sq. ft.).

FUSELAGE.—All-wood monocoque structure in two sections, bolted together, with fabric covering overall.

TAIL UNIT.—Cantilever monoplane type. All-wood structure. Fin and tailplane plywood-covered, rudder and elevators fabric-covered. Controllable trim-tab in elevator. Areas: fin 0.68 m.² (7.32 sq. ft.), rudder 0.58 m.² (6.24 sq. ft.), elevators

1.05 m.² (11.30 sq. ft.), tailplane 1.65 m.² (17.76 sq. ft.). Tailplane span 3.46 m. (11 ft. 4 in.).

LANDING GEAR.—Retractable tricycle type. Electric retraction with emergency mechanical release. Doors close when wheels are extended. Air-oil shock-absorbers. Single-disc hydraulic brakes. Steerable nose-wheel.

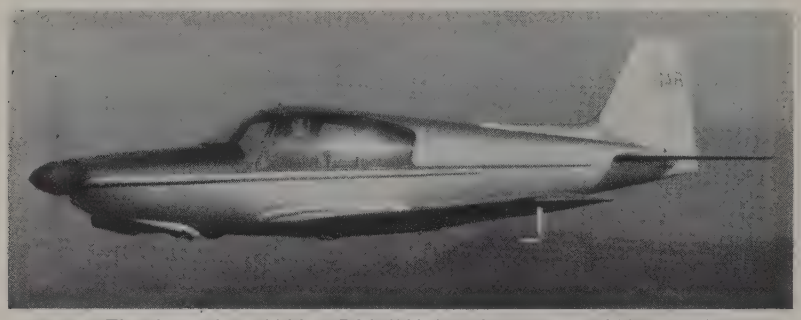
POWER PLANT.—One 180 h.p. Lycoming O-360 four-cylinder horizontally-opposed air-cooled engine, driving two-blade Hartzell metal constant-speed airscrew. Fuel in two rubber tanks in wings with total capacity of 150 litres (33 Imp. gallons).

ACCOMMODATION.—Four seats in enclosed cabin. Two seats side-by-side in front with dual controls. Full-width seat behind. Cabin dimensions 2.10 m. (6 ft. 11 in.) long, 1.08 m. (3 ft. 6½ in.) wide, 1.18 m. (3 ft. 10½ in.) high. Access door on starboard side. Space for 35 kg. (77 lb.) baggage behind rear seat. Full blind-flying equipment. Combined heating and ventilation system. Fiberglass soundproofing.

DIMENSIONS.—
Span 9.50 m. (31 ft. 1½ in.).
Length 7.25 m. (23 ft. 9½ in.).
Height 2.46 m. (8 ft. 1 in.).



The Aviamilano Nibbio F.14 (180 h.p. Lycoming O-360 engine).



The Aviamilano Nibbio F.14 (180 h.p. Lycoming O-360 engine).

WEIGHTS AND LOADINGS.—
Weight empty 650 kg. (1,433 lb.).
Weight loaded 1,100 kg. (2,425 lb.).
Wing loading 85.3 kg./m.² (17.5 lb./sq. ft.).
Power loading 6.1 kg./h.p. (13.5 lb./h.p.).

PERFORMANCE.—
Max. speed at S/L 330 km.h. (205 m.p.h.).
Cruising speed at 1,500 m. (5,000 ft.) 300 km.h. (186 m.p.h.).
Stalling speed at S/L. (30° flaps) 87 km.h. (54 m.p.h.).
Time to 2,000 m. (6,500 ft.) 8 min.
Service ceiling 5,400 m. (17,700 ft.).
Take-off run 180 m. (590 ft.).
Take-off distance to clear 15 m. (50 ft.) 450 m. (1,475 ft.).
Landing run 150 m. (490 ft.).
Range with 30 min. reserve, 1,000 km. (620 miles).

THE AVIAMILANO FALCO F.8L SERIES II.

The Falco F.8 is a high-performance two-seat lightplane, which flew in its original form on June 15, 1955, and in its present, developed, form on April 25, 1956. It is suitable for use as an *ab initio* trainer, an advanced trainer for instrument flying and aerobatics or as a touring aircraft.

The initial production series of ten aircraft, delivered by Aviamilano in 1956, had 135 h.p. Lycoming engines and are known as Falco F.8L Series I aircraft. The second series of twenty F.8L Series II aircraft, completed during 1957, differ in having a 150 h.p. Lycoming engine, metal airscrew and wing fuel tanks. A third series, now in production, is similar to the second series, to which the following description refers.

TYPE.—Side-by-side Two-seat Cabin monoplane.

WINGS.—Low-wing cantilever monoplane. Laminar-flow NACA 64000 series wing section, with 12½% t/c. ratio at root and 10% at tip. Aspect ratio 6.4. All-wood one-piece single-spar structure built integrally with forward portion of fuselage. Plywood-covered. All-wood ailerons and electrically-operated split flaps. Total area of ailerons 0.90 m.² (9.69 sq. ft.). Total area of flaps 1.07 m.² (11.52 sq. ft.). Wing area 10 m.² (107.5 sq. ft.).

FUSELAGE.—All-wood monocoque structure in two sections, bolted together. Forward section integral with wing. Plywood-covered.

TAIL UNIT.—Cantilever monoplane type. All-wood structure integral with rear portion of fuselage. Tailplane and fin plywood-covered. Rudder and elevators fabric-covered. Controllable trim-tab in elevator. Area of tailplane 2.20 m.² (23.7 sq. ft.). Span of tailplane 3.0 m. (9 ft. 10 in.).

LANDING GEAR.—Retractable tricycle type. Electro-mechanical retraction. Doors close when wheels are extended. Air-oil shock-absorbers. Single-disc hydraulic brakes. Steerable nose-wheel.

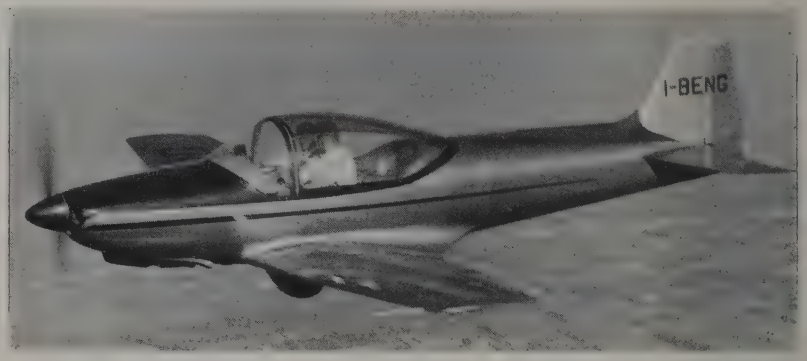
POWER PLANT.—One 150 h.p. Lycoming O-320 four-cylinder horizontally-opposed air-cooled engine, driving two-blade fixed-pitch metal airscrew, 1.80 m. (5 ft. 10 in.) diameter. Fuel in two rubber wing tanks with total capacity of 120 litres (26.4 Imp. gallons).

ACCOMMODATION.—Enclosed cabin for two persons. Rearward-sliding transparent canopy. Seats have provision for back-type parachutes. Cabin heating. Baggage locker behind seats.

DIMENSIONS.—
Span 8.0 m. (26 ft. 3 in.).
Length 6.5 m. (21 ft. 4 in.).
Height 2.27 m. (7 ft. 6 in.).

WEIGHTS AND LOADINGS.—
Weight empty 515 kg. (1,135 lb.).
Weight loaded 780 kg. (1,720 lb.).
Wing loading 78 kg./m.² (16.0 lb./sq. ft.).
Power loading 5.2 kg./h.p. (11.5 lb./h.p.).

PERFORMANCE.—
Max. speed at S/L. 345 km.h. (214 m.p.h.).
Cruising speed at 1,500 m. (5,000 ft.) 310 km.h. (193 m.p.h.).
Stalling speed (30° flaps) 85 km.h. (53 m.p.h.).
Rate of climb at S/L. 325 m./min. (1,065 ft./min.).
Service ceiling 5,800 m. (19,000 ft.).
Landing run 130 m. (425 ft.).
Range with 30 min. reserve 1,100 km. (685 miles).



The Aviamilano Falco F.8L Series II (150 h.p. Lycoming O-320 engine).

FIAT

SOCIETÀ PER AZIONI FIAT.

HEAD OFFICE: CORSO GIOVANNI AGNELLI, 200, TURIN.

President and Managing Director: Prof. Vittorio Valletta.

Managing Director: Ing. Gaudenzio Bono.

Aviation Division Manager: Ing. Giuseppe Gabrielli.

The branch of the Fiat organisation which is engaged in the production and testing of aircraft and engines is known as:—

FIAT—STABILIMENTI AVIO.

HEAD OFFICE: VIA NIZZA 250, TURIN.

Manager: Ing. Giovanni Perosino.

It includes the following establishments:—

STABILIMENTO VELIVOLI (Aircraft Factory).

WORKS: CORSO FRANCIA 366, TURIN.

STABILIMENTO MOTORI AVIO (Aero-Engine Factory).

WORKS: VIA NIZZA 312, TURIN.

OFFICINE DI CASELLE (Caselle Works). including an Aviation Electronics Centre.

WORKS: TURIN AIRPORT, CASELLE TORINESE.

OFFICINE DEL SANGONE (Sangone Works).

WORKS: STRADA DEL DROSSO, TURIN.

The direction and technical and commercial departments of the central organization co-ordinate the activities of the four above-mentioned establishments, each of which has its own managerial staff.

Since the war, Fiat has supplied many hundreds of piston-engined G.55 fighters



The Fiat G.91 Single-seat Light Tactical Fighter (Bristol Orpheus turbojet engine).

and G.46, G.55 and G.59 training aircraft to the Italian Air Force and the air forces of several foreign countries. It has also built prototypes of an intermediate piston-engined trainer designated the G.49 and a quantity of G.80 and G.82 jet-powered operational trainers which are in service with the Italian Air Force. All of these types have been described in earlier editions of "All the World's Aircraft."

The company is engaged at the present time on the design, development and production of a variety of civil and military aircraft, helicopters, piston-engines, gas-turbines and electronic equipment.

Its most important product in the aircraft field is the G.91 light jet ground attack fighter which, as the result of competitive trials against other types in 1957, has been chosen as the standard NATO tactical fighter and is now in series production in three versions.

Fiat has also been building under licence since 1955 the North American F-86K all-weather interceptor for service with NATO air forces. Production was completed in 1958, after 231 aircraft had been built for the Italian Air Force (65), French Air Force (68), Federal German Air Force (88), Royal Norwegian Air Force (5) and Royal Netherlands Air Force (5).

In the helicopter field, Fiat has begun construction of a prototype of its Model 7002 general-purpose helicopter, to meet requirements of the Italian Air Force. It is also developing other new projects in both its aircraft and engine divisions.

Fiat is also building for the French Sud-Aviation company components of the SE.210 Caravelle twin-jet airliner, as well as mechanical components for the Sikorsky S-58 helicopter.

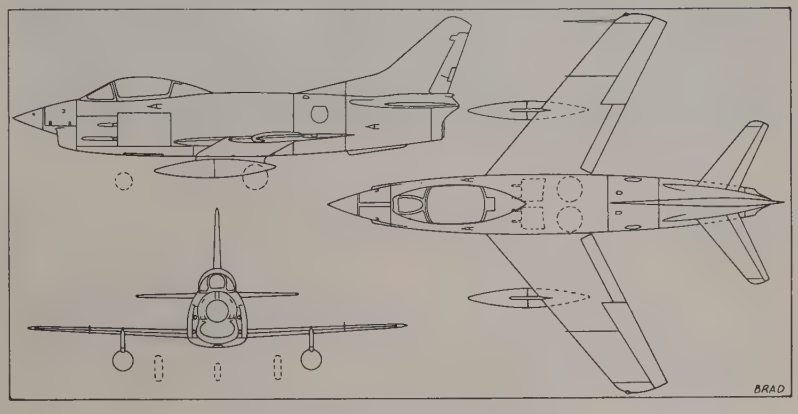
Details of the company's aero-engine activities are given in the "Gas-Turbines" section of this work.

THE FIAT G.91.

The G.91 is a light ground attack fighter, designed in accordance with NATO operational requirements for a light-weight tactical strike fighter which were issued in the Spring of 1954 to the aircraft manufacturers of Western Europe. After the initial evaluation of the designs submitted, the Fiat G.91 was recommended for construction.

Whilst the G.91 was still in the project stage, Fiat was awarded a contract for the construction of three prototypes and 27 pre-production aircraft, including two G.91T two-seat trainers and four G.91R reconnaissance variants.

In the technical evaluation trials carried out at Brétigny, France, in the Autumn of 1957, the G.91 proved itself able to meet the requirements of the official specification when operated from semi-prepared airstrips, with and without external stores, as a result of which it has been ordered into production as the standard NATO light tactical fighter until 1962.



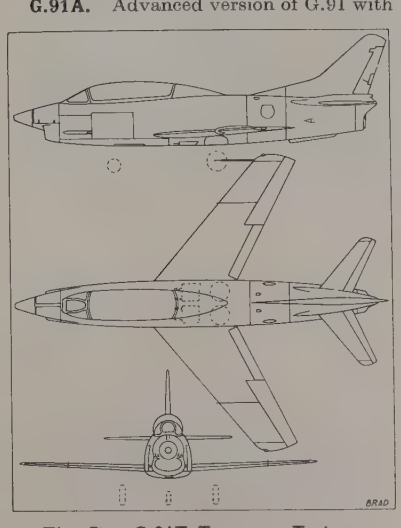
The Fiat G.91 Light Tactical Fighter.

A total of 150 G.91's is reported to have been ordered, in equal numbers by Italy, France and Germany. In addition, 18 G.91T trainers have been ordered by the Italian government.

Five versions of the G.91 have been announced as follows :—

G.91. Basic single-seat ground attack fighter, with 2,200 kg. (4,850 lb.) s.t. Bristol Orpheus BOr.3 turbojet. First prototype flew on August 9, 1956.

G.91A. Advanced version of G.91 with automatic leading-edge slats and additional integral wing tankage of 360 litres (80 Imp. gallons) capacity. Wing span increased to 9.0 m. (29 ft. 6 in.) and area to 18.10 m.² (194.8 sq. ft.). Thickness/chord ratio reduced to 9%.



The Fiat G.91T Two-seat Trainer.

G.91R. Similar to G.91, but equipped for photographic-reconnaissance duties.

G.91S. Projected development with either 3,089 kg. (6,810 lb.) s.t. Bristol Orpheus BOr.12 or 2,700 kg. (5,950 lb.) s.t. Fiat 4032 turbojet. Wing sweepback increased to 38° and thickness/chord ratio decreased to 8%.

G.91T. Tandem two-seat version of G.91, for advanced training at transonic speeds. Bristol Orpheus BOr.4 turbojet (1,919 kg.=4,230 lb. s.t.).

The following details refer specifically to the G.91, but are generally applicable to the other versions.

TYPE.—Single-seat Ground Attack Fighter.

WINGS.—Cantilever low-wing monoplane. Laminar-flow aerofoil section. Sweepback at 25% chord 37°. All-metal two-spar structure in three portions, of which the centre-section is integral with fuselage. Outer wings easily detachable for transport or replacement. Ailerons fitted with irreversible hydraulic servo-control, with artificial "feel" and trimmer. Slotted flaps. Wing area 16.42 m.² (176.7 sq. ft.).

FUSELAGE.—All-metal semi-monocoque structure. Rear portion detachable for engine replacement. Two hydraulically-actuated door-type air-brakes side-by-side under centre fuselage.

TAIL UNIT.—Cantilever monoplane type. All-metal structure. Rudder and elevator statically and dynamically balanced. Electrically-actuated variable-incidence tailplane. Elevator fitted with irreversible hydraulic servo-control and artificial "feel." Rudder fitted with balance-tab, adjustable in flight. Horizontal tail area 2.50 m.² (26.91 sq. ft.).

LANDING GEAR.—Retractable tricycle type. Hydraulically-actuated. Low-pressure tyres. Main-wheel pressure 3.5 kg./cm.² (49.8 lb./sq. in.), nose-wheel pressure 3.0 kg./cm.² (42.7 lb./sq. in.). Nose-wheel equipped with hydraulic anti-shimmy device, releasable manually for ground manoeuvring. Hydraulic brakes. Braking parachute stowed at base of rudder.

POWER PLANT (G.91 and G.91R only).—One Bristol Orpheus BOr.3 turbojet engine (2,200 kg. = 4,850 lb. s.t.). Fuel in armoured fuselage tankage.

ACCOMMODATION.—Pilot on Martin-Baker Mk. 4 fully-automatic ejection seat in armoured, pressurised and air-conditioned cabin. Electronic and manual temperature control. Electrically-operated jettisonable rearward-hingeing canopy. Automatically-controlled oxygen system.

ARMAMENT.—Normal fixed armament of 4 × 12.7 mm. machine-guns in fuselage, two on each side of cockpit. Provision for alternative mounting of two 20 mm. or 30 mm. cannon. Two underwing pylons for alternative loads of 5 in. air-to-ground rockets, honeycomb packs of 30 air-to-air folding-fin rockets, clusters of 6 × 3 in. air-to-ground rockets, 500 lb. bombs, nuclear weapons, or Nord 5103 air-to-air guided weapons.

DIMENSIONS (G.91 and G.91R).—
Span 8.60 m. (28 ft. 3 in.).
Length 10.40 m. (34 ft. 1 in.).
Height 4.00 m. (13 ft. 1 in.).

DIMENSIONS (G.91A).—
Same as G.91 except :—
Span 9.0 m. (29 ft. 6 in.).

DIMENSIONS (G.91T).—
Same as G.91 except :—
Length 11.10 m. (36 ft. 6 in.).

WEIGHT (G.91).—
Weight loaded, without external stores 4,700 kg. (10,360 lb.).

WEIGHT (G.91A).—
Weight loaded, without external stores 5,100 kg. (11,240 lb.).

WEIGHT (G.91S).—
Weight loaded, without external stores 5,800 kg. (12,790 lb.).

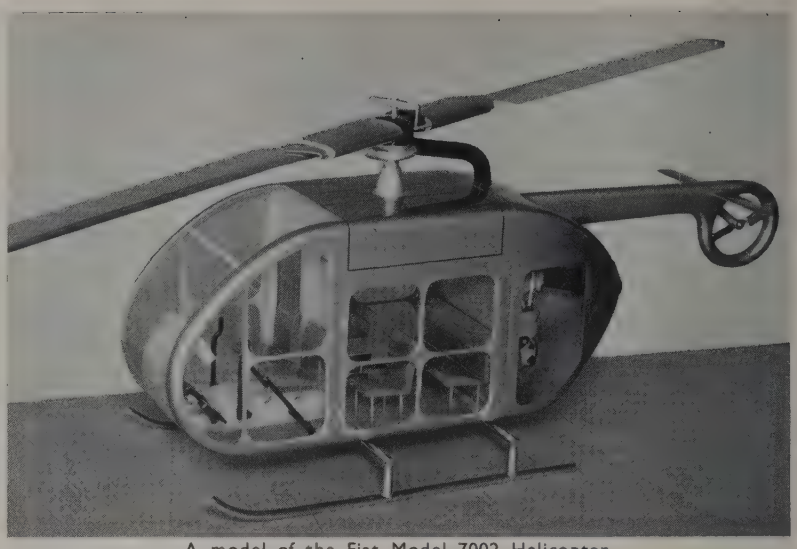
WEIGHTS AND LOADINGS (G.91T).—
Weight empty 2,750 kg. (6,050 lb.).
Weight loaded 5,000 kg. (11,000 lb.).
Wing loading 300 kg./m.² (60 lb./sq. ft.).
Power loading 2.45 kg./kg. s.t. (2.45 lb./lb. s.t.).

PERFORMANCE (G.91).—
Max. speed Mach 0.91 at 6,100 m. (20,000 ft.).
Max. diving speed above Mach 1 at 9,150 m. (30,000 ft.).
Stalling speed approx. 205 km.h. (127 m.p.h.).
Take-off distance from grass to 15 m. (50 ft.), with external stores, approx. 1,000 m. (3,280 ft.).
Landing distance on grass under 500 m. (1,640 ft.).
Endurance at S/L approx. 1 hour.

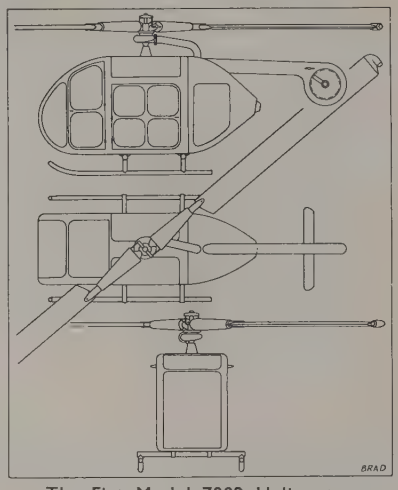
PERFORMANCE (G.91A, estimated).—
Max. speed Mach 0.92.
Take-off distance without external stores 480 m. (1,575 ft.).
Take-off distance with external stores 610 m. (2,000 ft.).

PERFORMANCE (G.91S, estimated).—
Max. speed Mach 0.94.

PERFORMANCE (G.91T, estimated).—
Max. speed 1,050 km.h. (652 m.p.h.) at S/L.
Limiting Mach No. 1.17.
Endurance 1 hr. 40 min.



A model of the Fiat Model 7002 Helicopter.



The Fiat Model 7002 Helicopter.

THE FIAT MODEL 7002.

The Fiat 7002 is a medium-capacity dual-control helicopter for passenger transport and general-purpose duties, of which a protoype is under construction. The main rotor is of the "cold jet" type, and is turned by ejecting compressed air, without any form of combustion, from nozzles at the blade-tips. Compressed air is provided by a Fiat 4700 turbo-generator. A small ducted tail rotor, mechanically-driven by the main rotor, ensures good manoeuvrability at low forward speeds and in autorotation.

TYPE.—Single-rotor general-purpose helicopter.

ROTOR SYSTEM.—Two-blade main rotor on tilting hub. Blades have leading-edge and spar of welded stainless steel sheet. Ducts in leading-edge and spar carry compressed air to propulsion nozzles at blade-tips. Blades linked together by steel strips which bear centrifugal loads and permit pitch variation. Blade chord 0.43 m. (1 ft. 5 in.). Small ducted two-blade tail rotor.

FUSELAGE.—Light alloy sheet structure in three portions. Front portion accommodates side-by-side pilot's seats; centre portion accommodates passengers or payload; rear portion carries power plant. Short semi-monocoque tail-boom carries ducted tail rotor and small horizontal stabiliser.

LANDING GEAR.—Twin tubular-skid type.

POWER PLANT.—One Fiat 4700 turbo-generator with equivalent power of 530 h.p. housed vertically in rear of fuselage. Fuel in tanks above cabin, with total capacity of 525 litres (115 Imp. gallons).

ACCOMMODATION.—Two pilots, or pilot and passenger, side-by-side in front portion of fuselage, with dual controls. Large sideways-opening door on each side. Centre cabin for five passengers or 2.5 m.³ (88.3 cub. ft.) of freight, etc. In casualty evacuation rôle can carry pilot, attendant, two litters internally and two externally. Very large door on each side of main cabin.

DIMENSIONS.
Diameter of main rotor 12.00 m. (39 ft. 4 in.).
Length of fuselage 6.12 m. (20 ft. 1 in.).
Width of fuselage 1.40 m. (4 ft. 7 in.).
Overall height 2.88 (9 ft. 5½ in.).

WEIGHTS.—
Weight empty 600 kg. (1,323 lb.).
Normal loaded weight 1,400 kg. (3,087 lb.).

PERFORMANCE (estimated).—
Max. speed at S/L 170 km.h. (106 m.p.h.).
Cruising speed at S/L 135 km.h. (84 m.p.h.).
Service ceiling 3,400 m. (11,150 ft.).
Range 300 km. (185 miles).

GRIPO

COMPAGNIA GENERALE ELETTRODOMESTICI (Aircraft Division).

HEAD OFFICE AND WORKS: VIMODRONE (MILAN).

Managing Director: Dr. Franco Grieco.

The Compagnia Generale Elettrodomestici, the leading Italian manufacturer of electrical household equipment in general, and washing machines in particular, has formed an aeronautical division to build aircraft for private and executive use.

Its first product, designed by the Gruppo Costruzioni Aeronautiche of the Politecnico di Milano, is the Gripo G.G.7 four-seat cabin monoplane which is scheduled to fly in 1959. This aircraft has been designed to meet American CAR 3 requirements in the "utility" category, while a two-seat version will fulfil the "aerobatic" requirements.

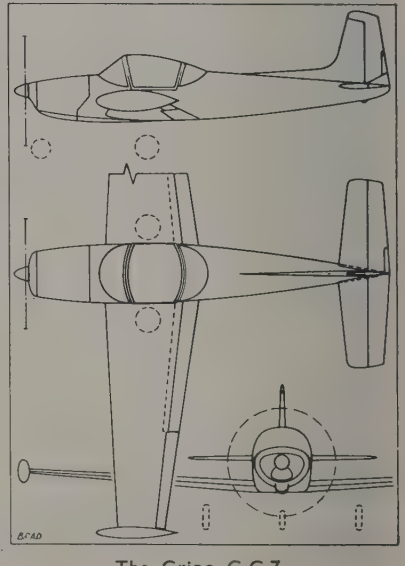
THE GRIPO G.G.7.

TYPE.—Four-seat touring or executive monoplane.

WINGS.—Low-wing cantilever monoplane. Wing section NACA 230-15 (NACA 4412 at tips). All-metal structure with stressed skin. All-metal statically and aerodynamically balanced ailerons. Flaps inboard of ailerons. Detachable wing-tip tanks. Gross wing area 13.6 m.² (146.3 sq. ft.).

FUSELAGE.—All-metal stressed skin structure.

TAIL UNIT.—Cantilever monoplane type. All-metal structure. Trim-tab in starboard elevator and in rudder.



The Gripo G.G.7.

LANDING GEAR.—Retractable tricycle type. Main wheels raised inward, nose-wheel backward. Hydraulic shock absorbers.
POWER PLANT.—One 190 h.p. Lycoming O-435A six-cylinder horizontally-opposed air-cooled engine. Constant speed metal airscrew. Main fuel in detachable wing-tip tanks. Central tank for long-range flying.
ACCOMMODATION.—Enclosed cabin seating four in two pairs, front pair with dual controls. Sliding moulded plastic canopy. Baggage compartment behind rear seats.
DIMENSIONS.—
Span 10 m. (32 ft. 9⅛ in.).
Length 7.05 m. (23 ft. 1 in.).
WEIGHTS AND LOADING (designed).—
Weight empty equipped 620 kg. (1,496 lb.).
Disposable load 420 kg. (924 lb.).
Weight loaded 1,100 kg. (2,420 lb.).
Wing loading 81 km./m.² (395.5 lb./sq. ft.).
Power loading 5.75 kg./h.p. (12.65 lb./h.p.).
PERFORMANCE (estimated).—
Max. speed 335 km.h. (208 m.p.h.).
Cruising speed (70% power) 290 km.h. (180 m.p.h.).
Min. speed (with flaps) 84 km.h. (52 m.p.h.).
Service ceiling 5,000 m. (16,400 ft.).
Normal range 700 km. (435 miles).
Max. range (with auxiliary tank) 1,300 km. (810 miles).

LUALDI

AER LUALDI & C. S.p.A.

HEAD OFFICE: 95, VIA PANAMA, ROME.

President: Gen. Prospero Del Din.

General Manager: Ing. Arnaldo Bertuzzi.

Aer Lualdi has built the prototype of a light helicopter known as the L.55. This incorporates the "Rotor-Matic" type of rotor system designed by Hiller Helicopters of Palo Alto, California, for whom Aer Lualdi are agents and licencees in Italy. Other features are covered by patents held by Engineers Carlo Lualdi, Glanco Corbellini and Arnoldo Bertuzzi.

First exhibited at the 1957 Milan Fair, the L.55 was built after several years of research, study and development testing. In particular it is claimed to be extremely simple to fly, by reason of special automatic devices which keep the engine r.p.m. constant even though the power absorbed by the main rotor varies, and which ensure correct tail rotor pitch at all times.

Aer Lualdi plan to make extensive use of reinforced plastics in production versions of the L.55 and claim that the initial and operating costs of production machines will be approximately half those of other comparable helicopters. The prototype was engaged on tests to obtain its Italian Certificate of Airworthiness in the Spring of 1958.

Aer Lualdi have an agreement with Aeromere S.p.A. of Trento, under which the L.55 will be built in the former Caproni works at Gardolo, Trento.



The Aer Lualdi L.55 Helicopter (180 h.p. Lycoming O-360 engine).

THE AER LUALDI L.55.

TYPE.—Four-seat Light General-purpose helicopter.
ROTOR SYSTEM.—One two-blade semi-rigid main rotor of wooden construction with NACA 0015-0012 aerofoil section. Cyclic pitch control of Hiller "Rotor-Matic" type with Lualdi gyro-stabilizer. Two-blade reinforced plastic tail rotor.
FUSELAGE.—All-metal structure on prototype. Monocoque tail-boom.
LANDING GEAR.—Tubular skid type, with retractable wheels for ground handling. Skid track 2.20 m. (7 ft. 2½ in.).
POWER PLANT.—One 180 h.p. Lycoming O-360 four-cylinder horizontally-opposed air-cooled engine with supplementary cooling fan. Fuel in two tanks with total capacity of 140 litres (31 Imp. gallons). Provision for auxiliary tank, capacity 27 litres (6 Imp. gallons).
ACCOMMODATION.—Four seats in two pairs, with dual controls for front pair. One of front seats and one fuel tank can be removed to permit loading of a stretcher through nose hatch. There is space for baggage and a hoist can be fitted.
DIMENSIONS.—
Main rotor diameter 10.0 m. (32 ft. 9½ in.).
Tail rotor diameter 1.57 m. (5 ft. 2 in.).
Overall length 11.90 m. (39 ft.).
Height 2.90 m. (9 ft. 6 in.).
WEIGHTS.—
Weight empty 600 kg. (1,323 lb.).
Pilot and 3 passengers 280 kg. (617 lb.).
Fuel and oil 90 kg. (198 lb.).
Baggage 30 kg. (66 lb.).
Weight loaded 1,000 kg. (2,204 lb.).
Disc loading 9.75 kg./m.² (2.0 lb./sq. ft.).
PERFORMANCE.—
Max. speed 155 km.h. (95 m.p.h.).
Cruising speed (75% power) 129 km.h. (80 m.p.h.).
Rate of climb at S/L 300 m./min. (984 ft./min.).
Hovering ceiling, in ground effect 2,800 m. (9,185 ft.).
Absolute ceiling 4,000 m. (13,125 ft.).
Endurance 3 hours.

M.d.B.

MARIO DE BERNARDI.

Col. Mario de Bernardi, who won for Italy the 1926 contest for the Schneider Trophy, has designed a two-seat ultra-light aircraft known as the Aeroscooter.

The prototype was built by the Partenavia company, under whose name it was described in the 1957-58 edition of "All the World's Aircraft." It was intended to be fitted with a two-blade free-turning rotor to reduce its stalling speed and rate of descent with engine off, but this feature has been abandoned on the production version of the Aeroscooter which was demonstrated at Urbe Airport, Rome, late in 1957 and is described hereafter.



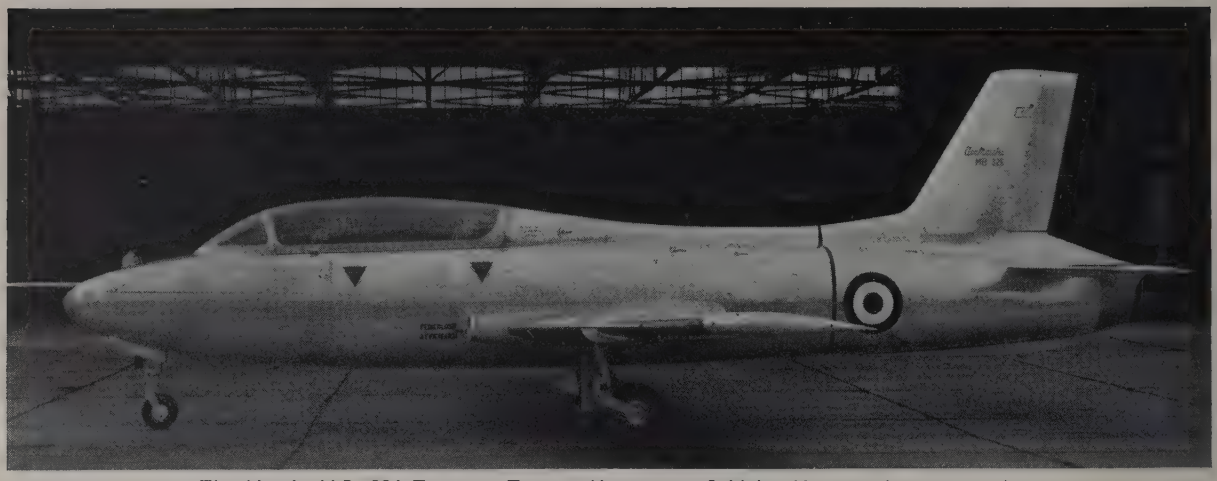
The first production M.d.B. Aeroscooter (72 h.p. Praga engine).

THE M.d.B. AEROSCOOTER.

The first production-type Aeroscooter is fitted with a 72 h.p. Praga engine, but later models are intended to have an 83 h.p. Agusta G.A.70/0 engine and the following details apply to the Agusta-powered version.

TYPE.—Two-seat Ultra-light monoplane.
WINGS.—Cantilever monoplane type. NACA 6 series wing section. One-piece parallel-chord all-wood single-spar structure, with ailerons and flaps of similar construction.
FUSELAGE.—Steel-tube forward structure and aluminium monocoque tail-boom, assembled together by six steel bolts.
TAIL UNIT.—Braced monoplane type. Steel-tube structure with fabric covering. Tail-plane mounted part-way up fin and braced each side by two metal struts.
LANDING GEAR.—Non-retractable nose-wheel type. Brakes on main wheels.
POWER PLANT.—One 83 h.p. Agusta G.A. 70/0 four-cylinder horizontally-opposed air-cooled engine, driving a two-blade fixed-pitch airscrew. Fuel in two tanks in fuselage, one forward of the cockpit with a capacity of 25 litres (5.5 Imp. gallons) and one aft of cockpit with capacity of 35 litres (7.7 Imp. gallons). Total fuel capacity 60 litres (13.2 Imp. gallons).
ACCOMMODATION.—Two seats side-by-side in enclosed cabin, under forward-sliding transparent canopy. Dual controls.
DIMENSIONS.—
Span 9.5 m. (31 ft. 2 in.).
Length 5.5 m. (18 ft. 0½ in.).
WEIGHTS.—
Weight empty 260 kg. (573 lb.).
Weight loaded 460 kg. (1,014 lb.).
PERFORMANCE.—
Max. speed 210 km.h. (130 m.p.h.).
Cruising speed 190 km.h. (118 m.p.h.).
Stalling speed 50 km.h. (31 m.p.h.).
Rate of climb at S/L 360 m./min. (1,180 ft./min.).
Take-off distance 50 m. (164 ft.).
Landing distance 50 m. (164 ft.).
Range 600 km. (373 miles).

MACCHI



The Macchi M.B. 326 Two-seat Trainer (Armstrong Siddeley Viper turbojet engine).

AERONAUTICA MACCHI S.A.

HEAD OFFICE: CORSO VITTORIO EMANUELE 31, MILAN.

OFFICES AND WORKS: VIA SANVITO SILVESTRO 80, VARESE.

President: Dott. Ing. Paolo Foresio.

Technical Director and Chief Engineer: Ing. Ermanno Bazzocchi.

The Macchi company was founded in 1912 in Varese and its first aeroplane was built in 1913.

Between the wars it established for itself a world-wide reputation as the designer and builder of a series of racing seaplanes. The Macchi 7 flying-boat won the 1921 Schneider Trophy contest, the Macchi 39 the 1926 contest and the Macchi 52*bis* was second in the 1929 contest.

In October, 1933, a Macchi-Castoldi 72 established a World's Speed Record at 709.2 km.h. (440.67 m.p.h.), and this still stands to the credit of Italy as a seaplane record.

Since the end of the war the Macchi company has developed the M.B. 308 two-seat light cabin monoplane, the M.B. 320, a twin-engined six-seat monoplane, and the M.B. 323 trainer. The M.B. 308 has been supplied to both the Italian Air Force and to the civil air authorities, and it has also been built under licence in Argentina. A description of all three aircraft has appeared in previous editions of "All the World's Aircraft."

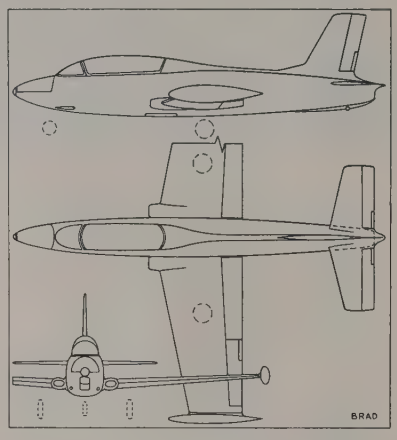
Macchi has also built the Fokker S.11 under licence for the Italian Government under the designation M.416 and has a contract for the overhaul and repair of Lockheed T-33 trainers used by the Italian Air Force.

The first of two prototypes of the Macchi M.B. 326 jet-trainer flew for the first time on December 10, 1957.

THE MACCHI M.B. 326.

TYPE.—Two-seat Jet-trainer.

WINGS.—Mid-wing cantilever monoplane. Wing section NACA 6A. Aspect ratio 5.26.



The Macchi M.B. 326.

Mean chord 1.9 m. (6.23 ft.). Dihedral 2° 55′. Incidence 2½°. All-metal single-spar stressed-skin structure in three sections, of which the centre-section is integral with the fuselage. Servo-tab operated all-metal ailerons and Fowler flaps. Total area of ailerons 1.32 m.² (14.208 sq. ft.). Total area of flaps 2.62 m.² (28.2 sq. ft.). Gross wing area 19 m.² (204.5 sq. ft.).

FUSELAGE. — All-metal semi-monocoque structure. Dive-brake under centre fuselage, hydraulically operated.

TAIL UNIT.—All-metal cantilever monoplane structure. Areas: fin 1.69 m.² (18.19 sq. ft.), rudder 0.75 m.² (8.07 sq. ft.), tailplane 2.69 m.² (28.96 sq. ft.), elevators 1.07 m.² (11.52 sq. ft.). Tailplane span 4.08 m. (13 ft. 4½ in.).

LANDING GEAR. — Hydraulically-retracted nosewheel type, with oleo-pneumatic shock-absorber struts. Hydraulic brakes. Steerable nose-wheel. Wheel-base 4.17 m. (13.68 ft.). Wheel track 2.37 m. (7.78 ft.).

POWER PLANT.—One Armstrong Siddeley Viper ASV.8 axial-flow turbojet engine (1,750 lb.=790 kg. s.t.). Capacity of fuselage fuel tank 860 litres (190 Imp. gallons). Two droppable 150 litre (33 Imp. gallons) wing-tip tanks may also be fitted.

ACCOMMODATION.—Crew of two in tandem under a one-piece moulded Perspex sideways-hingeing canopy. Pressurised cabin. Dual controls and instruments. Blind flying screens for pupil. Martin-Baker Mk. 4 lightweight ejection seats. Equipment includes VHF radio and radio-compass.

ARMAMENT.—Two 7.7 mm. machine-guns in fuselage, gun-camera. Four 6 kg. (13.2 lb.) or 7.5 kg. (16.7 lb.) rockets and four 15 kg. (33 lb.) or 45 kg. (100 lb.) bombs under wings.

DIMENSIONS.—
Span 10.04 m. (32 ft. 11 in.).
Length 10.50 m. (34 ft. 5 in.).
Height 3.46 m. (11 ft. 4 in.).

WEIGHTS.—
Weight empty 1,950 kg. (4,299 lb.).
Crew (2) 170 kg. (375 lb.).
Fuel 685 kg. (1,510 lb.).
Radio equipment 45 kg. (99 lb.).
Weight loaded 2,850 kg. (6,283 lb.).
Wing loading 144.7 kg./m.² (30.72 lb./sq. ft.).
Power loading 3.59 kg./kg. s.t. (3.59 lb./lb. s.t.).

PERFORMANCE (Estimated).—
Max. speed at 9,000 m. (29,500 ft.) 725 km.h. (450.5 m.p.h.).
Cruising speed at 6,000 m. (19,700 ft.) 470 km.h. (292 m.p.h.).
Min. speed (flaps retracted) 145 km.h. (90 m.p.h.).
Min. speed (flaps down) 139 km.h. (80 m.p.h.).
Rate of climb at S/L. 930 m./min. (3,050 ft./min.).
Climb to 3,000 m. (9,800 ft.) 4 min.
Climb to 6,000 m. (19,700 ft.) 9 min.
Climb to 9,000 m. (29,500 ft.) 18 min.
Service ceiling 11,000 m. (36,080 ft.).
Range at 9,000 m. (29,500 ft.) 1,330 km. (826 miles).
Take-off run 500 m. (1,640 ft.).
Landing-run, with brakes 280 m. (920 ft.).

METEOR

METEOR S.p.A. COSTRUZIONI AERONAUTICHE.

HEAD OFFICE: 2 VIA MILANO, TRIESTE.

ROME OFFICE: 29 VIA DALMAZIA.

WORKS: AEROPORTS METEOR, MONFALCONE.

Chairman and Managing Director: Avv. Furio Lauri.

Meteor S.p.A. was formed in 1947 to undertake the manufacture of aircraft, the operation of feeder-line air services and the management and operation of airports.

Originally Meteor undertook the construction of gliders and sailplanes of various types, including the Meteor MS.18, MS.21, MS.30 and, under licence, the Canguru type sailplanes. The company continues to supply all accessories and equipment for glider flying, notably the Meteor Dolomiti glider-winch with automatic hydraulic gears and double cable drum.

In 1953 Meteor took over the aeronautical designs and equipment of Francis Lombardi & C. (formerly Azionari Vercellese Industrie Aeronautiche—AVIA) of Vercelli, whose products included the AVIA (Lombardi) FL.3 of which more than 500 were built between 1939 and 1948. The Meteor FL.53, FL.54 and FL.55, described below, are developments of the AVIA FL.3.

The latest Meteor product is the P.1 pilotless target drone a description of which follows.

THE METEOR P.1 TARGET DRONE.

The P.1 is a guided target drone for artillery training or tactical use. It meets the American "General Specification of the Design and Construction of Target Drones—MIL-D-18232 (AER)" dated October 18, 1954. Its various versions are distinguished as follows:—

Meteor P.1. Standard version for contact flying only. Fitted with radio guidance and servo controls, one of which is a gyro, but without a complete autopilot or a transmission system of flight information from the drone. If provided with echo radar-strengthening wing nacelles becomes P.1/R.

Meteor P.1/A. For both contact and "out-of-sight" flying. Fitted with radio guidance, servo-controls and complete

autopilot, but without flight information transmission system. If fitted with echo radar-strengthening wing nacelles becomes P.1/AR. When fitted with camera or TV recording set P.1/A and P.1/AR become P.1/AF and P.1/ARF respectivley.

Meteor P.1/ATR. For contact and out of contact flying with telecasting system of flight information and echo radar-strengthening devices. If fitted with camera or TV recording set becomes P.1/ATRF.

The general description which follows refers to the standard P.1 drone.

TYPE.—Propeller-driven Target Drone.

WINGS.—Mid-wing cantilever. Wing section NACA 23014 at root, modified NACA 43009 at tip. Monospar structure of Kitonal. Spaces between wing ribs filled with plastic flotation material. Unbalanced inset ailerons for right and left turn, trim-tab in starboard aileron for right and left bank. Total area of ailerons (less trim-tab) 0.0789 m.² (0.85 sq. ft.). Area of trim-tab 0.0108 m.² (0.117 sq. ft.). Gross wing area 1.876 m.² (20.2 sq. ft.).

FUSELAGE.—In three portions comprising a centre cylindrical section, a forward engine mounting and a truncated conical rear section. All of Kitonal.

TAIL UNIT.—Cantilever tailplane with circular fixed fins or end-plates. Servo-controlled elevators. Same structure as wings. Total area of tailplane 0.324 m.² (3.49 sq. ft.). Total elevator area 0.146 m.² (1.57 sq. ft.). Total area of fixed end-plates 0.284 m.² (3.06 sq. ft.). Span of tail 1.142 m. (3 ft. 9 in.).

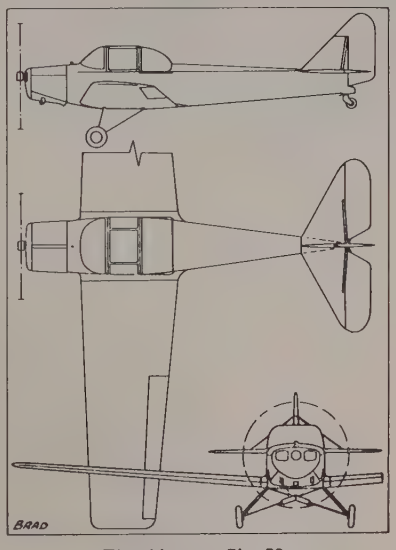
LAUNCHING.—P.1 can be launched by (*a*) long-run catapult (15 m.=49 ft. 2½ in.); (*b*) short-run catapult (10 m.=32 ft. 10 in.); (*c*) rocket-assist VTO; (*d*) circular flight take-off; or (*e*) air launch.

LANDING.—Recovery parachute (80 m.²=8,608 sq. ft.) stowed in forward section of fuselage cone is mechanically-ejected by engine-stop relay, and is automatically ejected if radio contact with ground is lost. Tubular skids attached to fuselage centre-section for protection when landing on ground. Low-density plastic material packed in wings and fuselage ensures flotation in sea landing.

POWER PLANT.—One Meteor G.80C four-cylinder X-type two-stroke air-cooled engine supercharged to maintain 80 h.p. to 3,500 m. (11,480 ft.). Two-blade fixed-pitch wood airscrew. NACA cowling. Fuel tank in fuselage centre section (63.2 litres=13.9 Imp. gallons).



The Meteor P.1 Target Drone (80 h.p. Meteor G.80C engine).



The Meteor FL. 53.

ELECTRONIC EQUIPMENT.—Tone-modulated 5-control receiver type Meteor RS 528; aileron gyro-servo control type Meteor SGA 24; elevator servo control type Meteor S 41; trim-tab servo control type Meteor S 41A; timer for trim-tab control; timer for parachute opening; junction box, aerial and 28-volt battery.

DIMENSIONS.—
Span 3.503 m. (11 ft. 6 in.).
Length 3.180 m. (10 ft. 5.2 in.).
Height 0.633 m. (2 ft. 0.9 in.).

WEIGHTS (P.1).—
Weight empty 126 kg. (278 lb.).
Weight loaded 170 kg. (375 lb.).

PERFORMANCE (P.1).—
Max. speed at S/L 370 km.h. (230 m.p.h.).
Max. speed at 3,500 m. (11,480 ft.) 430 km.h. (267 m.p.h.).
Rate of climb (constant) to 3,500 m. (11,480 ft.) 1,040 m./min. (3,346 ft./min.).
Time to 3,500 m. (11,480 ft.) 3 min. 25 sec.
Service ceiling 12,000 m. (39,360 ft.).
Duration at max. speed 70 min.

THE METEOR FL. 53.

TYPE.—Two-seat Trainer and Tourer.

WINGS.—Low-wing cantilever monoplane. All-wood structure. Differential ailerons. Flaps not normally fitted, but can be on request. Wing area 13.9 m.² (150 sq. ft.).

FUSELAGE.—Of mixed steel-tube and wood construction with fabric covering.

TAIL UNIT.—Braced monoplane type. Steel-tube framework covered with fabric.

LANDING GEAR.—Fixed tail-wheel type. Rubber-in-compression springing. Hydraulic brakes on main wheels. Steerable tail-wheel.

POWER PLANT.—One 60 h.p. C.N.A. D.4 or 65 h.p. Continental A65 four-cylinder air-cooled engine. Fuel tank (17 U.S. gallons=60 litres) in fuselage. Provision for external auxiliary tank of similar capacity below fuselage. Filler cap of latter tank accessible through hole in underside of fuselage to permit contents to be transferred to main tank by hand-pump.

ACCOMMODATION.—Two seats side-by-side with dual controls beneath sliding Plexiglas canopy. Roof and rear section of canopy tinted for glare protection. Seat backs are adjustable so that they can be used with or without parachutes. Canopy has spring release for emergency exit.

DIMENSIONS.—
Span 9.85 m. (32 ft. 3½ in.).
Length 6.37 m. (20 ft. 10½ in.).
Height 1.80 m. (5 ft. 10½ in.).

WEIGHTS.—
Weight empty 360 kg. (794 lb.).
Disposable load (normal) 220 kg. (484 lb.).
Disposable load (aerobatic) 190 kg. (419 lb.).
Weight loaded (normal) 570 kg. (1,254 lb.).
Weight loaded (aerobatic) 525 kg. (1,155 lb.).

PERFORMANCE (560 kg. A.U.W.—65 h.p. Continental engine).
Max. speed 165 km.h. (103 m.p.h.).
Cruising speed 143 km.h. (88 m.p.h.).
Initial rate of climb 120 m./min. (395 ft./min.).
Service ceiling 3,700 m. (12,140 ft.).
Stalling speed 40 km.h. (25 m.p.h.).
Take-off run (no wind) 170 m. (560 ft.).
Landing run (without brakes) 120 m. (395 ft.).
Endurance 3 hours normal, 6 hrs. with auxiliary tank.



The Meteor FL. 53 (60 h.p. C.N.A. D.4 engine).



The Meteor FL.54 Seaplane (90 h.p. Continental C90 engine).

THE METEOR FL.54.

The FL.54 is a three-seat higher-powered version of the FL.53. It can be fitted

with either the 85 h.p. or 90 h.p. Continental engine. The third seat is placed centrally in the rear of the cabin.

The FL.54 is a general purpose aircraft which can be used for touring, training, glider-towing, etc.

DIMENSIONS.—
Same as for FL.53.

WEIGHTS (90 h.p. Continental C90 and metal propeller).—
Weight empty 380 kg. (838 lb.).
Normal disposable load 272 kg. (600 lb.).
Normal loaded weight 700 kg. (1,543 lb.).

PERFORMANCE (695 kg. A.U.W., 90 h.p. Continental C90 engine).—
Max. speed 196 km.h. (122 m.p.h.).
Cruising speed 181 km.h. (113 m.p.h.).
Initial rate of climb 60 m./min. (200 ft./min.).
Service ceiling 2,500 m. (8,200 ft.).
Absolute ceiling 4,500 m. (14,760 ft.).
Stalling speed 67 km.h. (41.5 m.p.h.).
Take-off run (no wind) 300 m. (985 ft.).
Landing run (with brakes) 170 m. (560 ft.).
Endurance 2.3 hrs. normal, 5 hrs. with auxiliary tank.

THE METEOR FL.55.

The FL.55 is similar to the FL.54 but is a four-seater with a reinforced airframe and is fitted with a 130 h.p. or 150 h.p. Lycoming engine.

In addition to touring and training, the FL.55 can be adapted for agricultural work (spraying and dusting), high-altitude glider towing, etc. It can also be fitted with floats or skis.

The standard 4-seat version is fitted with dual controls, flaps, electric starter, VHF radio and standard instrument panel.

The spraying and dusting equipment, which can be installed or removed in 15 minutes, consists of a spray or dust tank with a normal capacity for 300 kg. (661 lb.), wind-driven centrifugal pump, gauges, controls and spray booms and 48 nozzles or a Venturi-type dust distributor. The tank is fitted in place of the third seat. During spraying or dusting operations the Plexiglas canopy is removed completely to facilitate refilling.



The Meteor FL.55B (150 h.p. Lycoming O-320 engine).

DIMENSIONS.—
Same as for FL.53.

WEIGHTS (Standard 150 h.p. 4-seat version).—
Weight empty 450 kg. (992 lb.).
Pilot and 3 passengers 300 kg. (666 lb.).
Fuel and oil 50 kg. (110 lb.).
Baggage 27 kg. (60 lb.).
Weight loaded 800 kg. (1,776 lb.).

WEIGHTS (150 h.p. Agricultural version).—
Weight empty 493 kg. (1,085 lb.).
Pilot 73 kg. (162 lb.).
Spraying liquid or dust 300 kg. (661 lb.).
Fuel and oil 50 kg. (110 lb.).
Weight loaded 900 kg. (1,984 lb.).

PERFORMANCE (Standard 150 h.p. 4-seat version).
Max. speed 214 km.h. (133 m.p.h.).
Cruising speed 190 km.h. (118 m.p.h.).
Initial rate of climb 120 m./min. (395 ft./min.).
Service ceiling 3,500 m. (11,500 ft.).
Take-off run (no wind) 230 m. (755 ft.).
Landing run (with flaps and brakes) 180 m. (590 ft.).
Endurance 2 hrs. normal, 4 hrs. with auxiliary tank.

PERFORMANCE (150 h.p. Agricultura version).—
Operational speed 90-120 km.h. (56-75 m.p.h.).
Stalling speed at gross weight 80 km.h. (50 m.p.h.).
Take-off run at gross weight (no wind) 220 m. (720 ft.).
Endurance 2 hours.

THE METEOR FL.55B.

Basically similar to the FL.55, the FL.55B differs in that it is fitted with a combination wheel-ski landing gear for operation in mountainous regions. When not in use, the metal skis are retracted hydraulically from the cockpit to a position just below the wheel axles.

After comparative trials of the prototype FL.55B against another lightplane, it was chosen in 1956 to equip a Swiss mountain rescue organisation. It is powered by a 150 h.p. Lycoming engine and carries a pilot and either three passengers or a stretcher.

DIMENSIONS.—
Same as for FL.53.

WEIGHTS.—
Same as for FL.55.

PERFORMANCE (800 kg. A.U.W.).—
Max. speed 205 km.h. (127 m.p.h.).
Cruising speed 180 km.h. (112 m.p.h.
Stalling speed 80 km.h. (50 m.p.h.).
Climb to 1,000 m. (3,050 ft.) 4 min. 10 sec.
Service ceiling 6,000 m. (19,700 ft.).
Take-off distance 120 m. (395 ft.).
Landing distance (with flaps and brakes) 130 m. (425 ft.).

NARDI

NARDI S.A. PER COSTRUZIONI AERONAUTICHE.

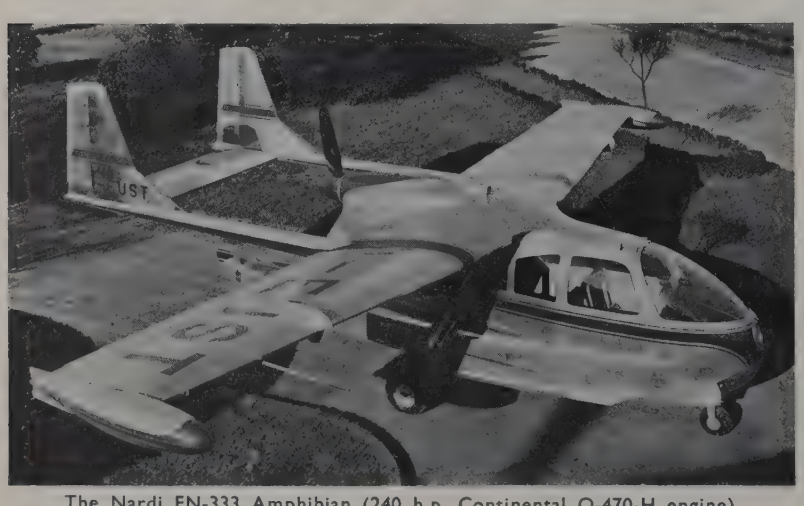
HEAD OFFICE AND WORKS: AEROPORTO FORLANINI, MILAN.

President: Dr. Ing. Luigi Nardi.
Vice-President: Dr. Elto Nardi.

This concern was established by the four Nardi brothers in Milan in 1933. Their first product, the F.N. 305, first flew in 1935.

The Nardi factory at Loreto was almost completely destroyed during the war, but the Milan factory has been rebuilt and the prototype of the company's first post-war aircraft, the FN-333 all-metal amphibian, flew for the first time on December 4, 1952. The first prototype was a three-seater and was powered by a 145 h.p. Continental engine. From this has been developed the four-seat production model of slightly larger dimensions and powered by a 240 h.p. Continental engine. A prototype of this version first flew on December 8, 1954, and an experimental model built to production standards for airworthiness approval made its first flight on October 14, 1956. Production aircraft will be manufactured by Fiat at Turin.

In addition to aircraft manufacture, the company has specialised in the production of wheels, brakes, retractable landing gears, hydraulic and electric aircraft controls, fuel pumps, armament installations and aircraft accessories generally.



The Nardi FN-333 Amphibian (240 h.p. Continental O-470-H engine).

THE NARDI FN-333.

TYPE.—Four-seat boat Amphibian.

WINGS.—High-wing cantilever monoplane. NACA 23000 Series wing section. Aspect ratio 6.5. Mean chord 1.51 m. (4.95 ft.). Dihedral 2°. Incidence 3°. Two-spar all-metal stressed-skin construction. Centre-section, attached to hull, carries tail-booms and engine mounting. All-metal slotted ailerons. All-metal split flaps inboard of ailerons. Total area of ailerons .97 m.² (10.4 sq. ft.). Total area of flaps 1.92 m.² (20.7 sq. ft.). Gross wing area 15.14 m.² (163 sq. ft.).

HULL.—Single-step all-metal stressed-skin structure. Hull below cabin floor has series of watertight compartments. Deck of rear portion provided with manholes and drain openings. Rudder hinged to sternpost.

TAIL BOOMS.—Each is a tapered tube made from a single duralumin sheet. Bolted to wing centre-section through flanged duralumin collars.

TAIL UNIT.—Rectangular tailplane between ends of booms. Fins riveted to booms. Statically and aerodynamically balanced elevator has central controllable trim-tab. Aerodynamically-balanced rudders. Entire tail unit is of metal stressed-skin construction. Areas: fins 2.28 m.² (24.6 sq. ft.), rudders 0.76 m.² (8.2 sq. ft.), elevators 1.0 m.² (10.7 sq. ft.), tailplane 1.49 m.² (16 sq. ft.). Tailplane span (centre-line of booms) 2.50 m. (8 ft. 2 in.).

LANDING GEAR. — Retractable nose-wheel type. Two main units are independent but are retracted by a single hydraulic jack. When retracted each unit is entirely buried in side of hull. Nardi hydraulic shock-struts. Wheels are of peralumin anti-corrosive alloy and have Nardi hydraulic disc brakes. Main wheel track 1.88 m. (6 ft. 2 in.). Wheelbase 2.80 m. (9 ft. 2 in.).

WING TIP FLOATS.—Retractable floats are of peralumin non-corrosive alloy and are carried on single struts. Hydraulic retraction. When raised are located at wing-tips.

Power Plant.—One 240 h.p. Continental O-470-H six-cylinder horizontally-opposed fan-cooled engine buried in centre-section. Hartzell constant-speed feathering pusher airscrew with armoured wood blades. Electric starter. Two fuel tanks in wings. Total fuel capacity 300 litres (66 Imp. gallons). Oil capacity 16 litres (3.5 Imp. gallons).

Accommodation.—Cabin seats four, two side-by-side in front with dual controls and two on a bench-type seat behind. Soundproofed, air-conditioned and heated cabin. Large door on each side and backs of front seats hinge forward to give access to rear seat. Radio. Electric position indicators for landing-gear, flaps and wing-tip floats. Baggage capacity 0.42 m.³ (15 cub. ft.).

Dimensions.—
Span 10.36 m. (34 ft. 0 in.).
Length overall 7.30 m. (23 ft. 11 in.).
Height overall 3.23 m. (10 ft. 7 in.).

Weights and Loadings.—
Weight empty 890 kg. (1,962 lb.).
Normal disposable load 460 kg. (1,014 lb.).
Max permissible disposable load: 513 kg. (1,130 lb.).
Normal loaded weight 1,350 kg. (2,976 lb.).
Max. permissible loaded weight 1,403 kg. (3,092 lb.).
Max. wing loading 87.9 kg./m.² (18 lb./sq. ft.).
Max. power loading 5.85 kg./h.p. (12.9 lb./h.p.).

Performance.
Max. speed at S/L. 290 km.h. (180 m.p.h.).
Cruising speed at 2,450 m. (8,000 ft.) 265 km.h. (165 m.p.h.).
Stalling speed with flaps 105 km.h. (65 m.p.h.).
Rate of climb at S/L. 390 m./min. (1,280 ft./min.).
Service ceiling 6,100 m. (20,000 ft.).
Normal range 900 km. (560 miles).
Max. range 1,245 km. (775 miles).
Take-off run on ground 275 m. (900 ft.).
Take-off run on water 420 m. (1,380 ft.).
Landing run on ground 200 m. (660 ft.).

PARTENAVIA

PARTENAVIA COSTRUZIONI AERONAUTICHE.

Head Office: Via Tasso 480, Naples.
Works: Arzano, Naples.

This company has built a series of light aircraft to the designs of Luigi Pascale, including the P-48-B Astore two-seat high-wing monoplane, which first flew in 1952, the P-52 Tigrotto three-seat low-wing monoplane of 1953 and the later P-55 Tornado.

A completely new four-seat touring aircraft, the P-57 Fachiro, is under development.

THE PARTENAVIA P-57 FACHIRO.

The Fachiro has been designed as a simple, inexpensive high-wing monoplane that can be powered by any engine in the 90-150 h.p. class. There are three basic versions:—

P-57-1. Four-seat touring and general purpose aircraft.

P-57-2. Side-by-side two-seat version with additional fuel tankage for long-range operation.

P-57-3. Tandem two-seat version for military observation and liaison duties.

Construction can be either all-metal or composite wood and metal. Aircraft of composite construction will be designated P-57-1M, P-57-2M and P-57-3M.

The following details refer specifically to the P-57-1M prototype, which is now being flight tested.

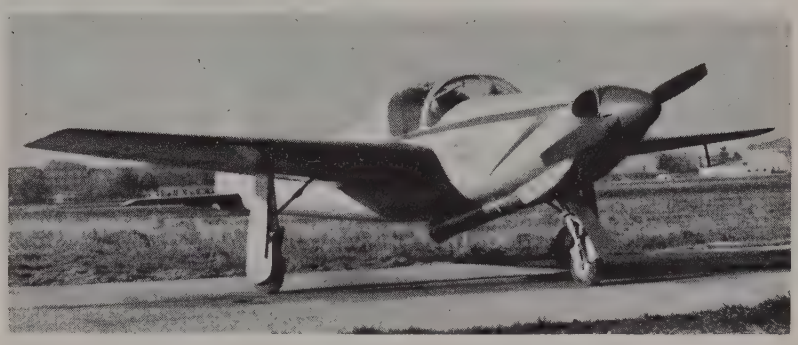
Type.—Four-seat Touring monoplane.

Wings.—High-wing braced monoplane. Aspect ratio 6.26. Mean chord 1.47 m. (4 ft. 10 in.). Single-spar all-wood structure with a single bracing strut on each side. Total area of ailerons 1.29 m.² (13.88 sq. ft.). Total area of flaps 1.45 m.² (15.50 sq. ft.). Gross wing area 13.5 m.² (145.3 sq. ft.).

Fuselage.—Welded steel-tube structure, with fabric covering.

Tail Unit.—Cantilever monoplane type. Wooden construction. Areas: fin 0.375 m.² (4.04 sq. ft.), rudder 0.73 m.² (7.86 sq. ft.), tailplane 1.20 m.² (12.92 sq. ft.), elevators (total) 1.125 m.² (12.11 sq. ft.).

Landing Gear.—Non-retractable nosewheel type with cantilever legs. Oleo shock-absorbers on all units. Steerable nose-wheel. Elektron wheels with Pirelli 7.00 × 6 tyres on main wheels. Hydraulic brakes.



The Partenavia P-55 Tornado (150 h.p. Lycoming O-320 engine).

Power Plant.—One 150 h.p. Lycoming O-320 four-cylinder horizontally-opposed air-cooled engine driving a two-blade Aeromatic fixed or controllable-pitch airscrew.

Accommodation.—Cabin seats four in two pairs, front pair with dual controls.

Dimensions.—
Span 9.2 m. (30 ft. 2 in.).
Length 6.16 m. (20 ft. 3 in.).
Height 1.93 m. (6 ft. 4 in.).

Weights and Loadings.—
Weight empty 489 kg. (1,078 lb.).
Weight loaded 903 kg. (1,991 lb.).
Wing loading 66.8 kg./m.² (13.68 lb./sq. ft.).
Power loading 6.02 kg./h.p. (13.27 lb./h.p.).

Performance (estimated).—
Max. speed 232 km.h. (144 m.p.h.).
Cruising speed 195 km.h. (121 m.p.h.).
Minimum speed 73 km.h. (45.5 m.p.h.).
Service ceiling 4,000 m. (13,125 ft.).
Climb to 1,000 m. (3,280 ft.) 5 min.

THE PARTENAVIA P-55 TORNADO.

Designed as a high-performance two-seat competition and touring aircraft, the Tornado has twice won the Giro di Sicilia contest. Despite its small size, it has a fully-retractable landing gear and can achieve 347 km.h. (216 m.p.h.) with full load on a 150 h.p. Lycoming engine.

Type.—Two-seat Cabin monoplane.

Wings.—Mid-wing cantilever monoplane. N.A.C.A. 6-series laminar-flow section. Aspect ratio 6.5. Chord at root 1.48 m. (4 ft. 9 in.), at tip 0.63 m. (2 ft. 1 in.). All-wood single-spar structure, plywood covered. Manually-operated flaps. Total area of ailerons 0.50 m.² (5.38 sq. ft.). Total area of flaps 0.92 m.² (9.90 sq. ft.). Wing area 8 m.² (86.1 sq. ft.).

Fuselage.—All-wood monocoque structure, plywood-covered.

Tail Unit.—Cantilever monoplane type. All-wood structure. Areas: fin 0.42 m.² (4.52 sq. ft.), rudder 0.21 m.² (2.26 sq. ft.), tailplane 0.78 m.² (8.40 sq. ft.)., elevators 0.50 m.² (5.38 sq. ft.).

Landing Gear.—Retractable tricycle type. Oleo-pneumatic shock-absorbers. Manual hydraulic retraction. Hydraulic brakes. Tyres Pirelli 400 × 100 (main wheels), 300 × 100 (nose-wheel).

Power Plant.—One 150 h.p. Lycoming O-320 four-cylinder horizontally-opposed air-cooled engine, driving two-blade fixed-pitch airscrew. Fuel capacity 120 litres (26.4 Imp. gallons).

Accommodation.—Enclosed cabin with side-by-side seating for two persons. Dual controls.

Dimensions.—
Span 7.20 m. (23 ft. 7½ in.).
Length 6.0 m. (19 ft. 9 in.).
Height 1.80 m. (5 ft. 10½ in.).

Weights and Loadings.—
Weight empty 480 kg. (1,058 lb.).
Weight loaded 710 kg. (1,565 lb.).
Wing loading 88.8 kg./m.² (18.19 lb./sq. ft.).
Power loading 4.73 kg./h.p. (10.42 lb./h.p.).

Performance.—
Max. speed 347 km.h. (216 m.p.h.).
Cruising speed 303 km.h. (188 m.p.h.).
Stalling speed 95 km.h. (59 m.p.h.).
Climb to 1,000 m. (3,280 ft.) 3 min.
Ceiling 6,000 m. (19,685 ft.).
Range 950 km. (590 miles).

PIAGGIO

PIAGGIO & C., SOCIETA' PER AZIONI.

Head Office: Via Antonio Cecchi 6, Genoa (434).

Branch Offices: Rome and Milan.

Works: Finale-Ligure, Pontedera, Pisa and Genoa-Sestri.

Managing Directors: Ing. Armando Piaggio and Dr. Enrico Piaggio.

Technical Directors: Ing. Filippo Schiaffino (Railway Division), Ing. Corradino D'Ascanio (Automotive Division), and Ing. Giovanni P. Casiraghi (Aircraft Division) and Ing. Guido Ferraris (Engine Division).

This famous engineering firm began the construction of aeroplanes in its Genoa-Sestri plant in 1916, and later in the Finale-Ligure works. In 1938 Plant No. 2 at Pontedera was built for the construction of large multi-engined all-metal aircraft.

The company's first post-war products were the Piaggio P.136 twin-engined amphibian flying-boat, twenty-three of which have been supplied to the Italian Air Force for training and coastal reconnaissance; and the P.148 two-seat primary trainer, which was adopted as a standard type by the Italian Air Force and has been described in earlier editions of "All the World's Aircraft."

The prototype of the P.149-D cabin monoplane derived from the P.148, of which it uses many structural parts, flew in July, 1953.

In 1955, the P.149-D was chosen for liaison and training duties with the new German Air Force. Seventy-five of these aircraft have been delivered by Piaggio; while the remainder will be built under licence in Germany by Focke-Wulf.

A licence to manufacture the P.136 amphibian in the United States has been acquired by the Trecker Aircraft Corporation. Trecker is assembling Italian-built aircraft and marketing them throughout the American continent under the name of Trecker Gull. Nearly 50 P.136's have been built.

Under development are a medium-sized amphibian, designed as the P.155-AS for anti-submarine duties, the P.155-SAM for air-sea rescue and the P.155-CT civil transport; and a six to eight-seat twin-engined executive landplane designated the P.166. Details of these aircraft are given hereafter.

THE PIAGGIO P.166.

The P.166 is a six to eight-seat executive landplane, based on the design of the P.136 amphibian. The prototype flew for the first time on November 26, 1957.

Type.—Twin-engined Light Executive transport.

Wings.—High gull-wing cantilever monoplane. NACA 230 wing section. Aspect ratio 7.3. Chord 2.40 m. (7 ft. 10½ in.) at root, 1.15 m. (3 ft. 9½ in.) at tip. Dihedral 21° 30′ on inner portion, 2° 8′ on outer wing. Incidence 2° 43′. All-metal aluminium-alloy flush-riveted single-spar structure. All-metal slotted ailerons, each

with trim-tab. All-metal slotted trailing-edge flaps. Total area of ailerons 1.95 m.² (21 sq. ft.). Total area of flaps 2.38 m.² (25.6 sq. ft.). Wing area 26.56 m.² (285.9 sq. ft.).

FUSELAGE.—All-metal aluminium-alloy flush-riveted semi-monocoque structure.

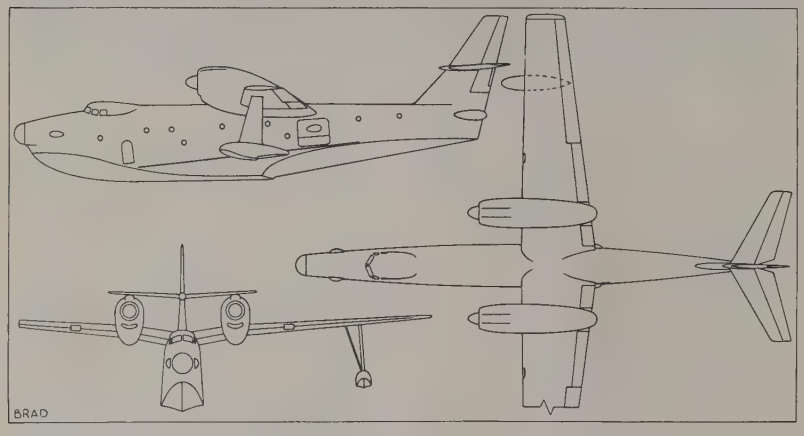
TAIL UNIT.—Cantilever monoplane type. All-metal aluminium-alloy flush-riveted structure. Trim-tabs in elevators and rudder. Areas: fin 1.62 m.² (17.44 sq. ft.), rudder 1.23 m.² (13.24 sq. ft.), tailplane 3.50 m.² (37.67 sq. ft.), elevators 1.29 m.² (13.88 sq. ft.). Tailplane span 5.10 m. (16 ft. 9 in.).

LANDING GEAR.—Retractable tricycle type. Oleo-pneumatic shock-absorbers. Hydraulic retraction. Goodyear 24×77 main wheels with 8.50-10 tyres. Goodyear 6.00×6 nose-wheel and tyre. Goodyear hydraulic brakes. Wheel track 2.66 m. (8 ft. 9 in.). Wheelbase 4.71 (15 ft. 5½ in.).

POWER PLANT.—Two Lycoming GSO-480-B1C6 six-cylinder horizontally-opposed air-cooled engines, each with take-off rating of 340 h.p. and normal rating of 320 h.p. Three-blade Piaggio or Hartzell feathering constant-speed pusher propellers. Fuel in two internal tanks in outer wings (each 215 litres = 47.3 Imp. gallons) and two external wing-tip tanks each 225 litres = 49.5 Imp. gallons). Total capacity 880 litres (193.6 Imp. gallons). Total oil capacity 32 litres (7.04 Imp. gallons).



The Piaggio P.166 Light Transport (two 340 h.p. Lycoming GSO-480 engines).



The Piaggio P.155-SAM.1 Rescue Flying-boat.

ACCOMMODATION.—Pilot's compartment at front seats two side-by-side, with dual controls. Passenger cabin seats 4-6 persons. Toilet and galley aft of cabin. Two baggage compartments with total capacity of 2.47 m.³ (87.3 cub. ft.). Individual lighting and ventilation controls. Sound-proofing, heating, folding card tables. Provision for weather radar in fuselage nose.

DIMENSIONS.—
Span 14.25 m. (46 ft. 9 in.).
Length 11.60 m. (38 ft. 1 in.).
Height 5.0 m. (16 ft. 5 in.).

WEIGHTS.—
Weight empty 2,290 kg. (5,044 lb.).
Weight loaded 3,450 kg. (7,600 lb.).
Wing loading 130 kg./m.² (26.6 lb./sq. ft.).
Power loading 5.1 kg./h.p. (11.2 lb./h.p.).

PERFORMANCE.—
Max. speed at 2,960 m. (9,700 ft.) 364 km.h. (226 m.p.h.).
Cruising speed (70% power) at 3,565 m. (11,700 ft.) 333 km.h. (207 m.p.h.).
Cruising speed (55% power) at 4,480 m. (14,700 ft.) 313 km.h. (194 m.p.h.).
Stalling speed with flaps 112.6 km.h. (70 m.p.h.).
Service ceiling 7,900 m. (25,900 ft.).
Service ceiling, one engine out 3,565 m. (11,700 ft.).
Take-off distance to 15 m. (50 ft.) 480 m. (1,575 ft.).
Landing distance from 15 m. (50 ft.) 500 m. (1,640 ft.).
Range (at 55% power), including allowances for starting, warm-up, taxiing, take-off and climb and 30 min. reserve, at 4,480 m. (14,700 ft.) 2,300 km. (1,430 miles).

THE PIAGGIO P.155.

The Piaggio P.155 is a large twin-engined amphibian, the prototype of which is due for completion during 1959. It is of conventional high-wing monoplane layout, with the tailplane mounted mid-way up its slightly-swept-back fin. The hull is of conventional form, with a single step and long after-body; and there is a fixed stabilising float under each outer wing.

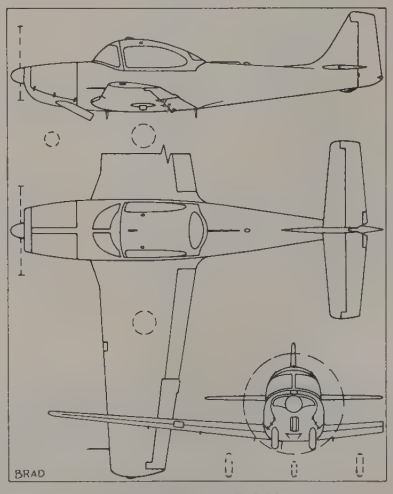
Three versions of the P.155 have been announced:—

P.155-SAM.1. Sea rescue version with a crew of seven and accommodation for ten stretcher cases and 5-10 other passengers. Two Pratt & Whitney R-2800 piston-engines. Designed to cruise at 260-350 km.h. (160-220 m.p.h.), with a maximum range of approximately 3,700 km. (2,300 miles).

P.155-AS. Naval reconnaissance and anti-submarine version. Reported to be designed with two turboprop engines and auxiliary turbojets.

P.155-CT. Commercial transport with accommodation for 20-30 passengers. Will have two turboprops in 3,000-4,000 h.p. category.

No further details are available.



The Piaggio P.149.

THE PIAGGIO P.149-D.

The P.149-D was developed from the P.148, which is a standard trainer in the Italian Air Force, and uses many of the same structural components. The prototype flew in July, 1953. Two years later the P.149-D was chosen for liaison and training duties with the German Air Force, and is being built under licence by the Focke-Wulf company in Germany.

TYPE.—Four-five seat Cabin Utility/Two-seat Aerobatic monoplane.

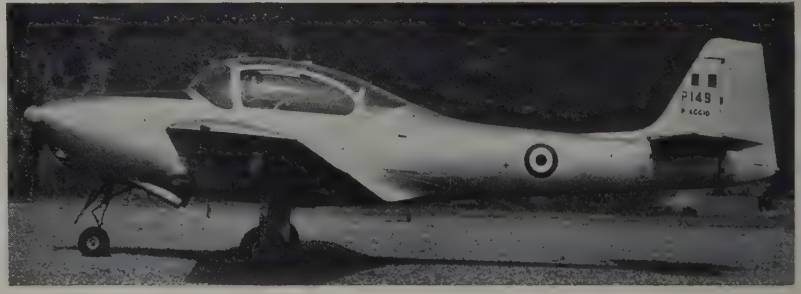
WINGS.—Cantilever low-wing monoplane. Wing section derived from NACA 230 and 4412. Aspect ratio 6.6. Taper ratio 2:1. Dihedral 6°. All-metal aluminium-alloy riveted single-spar structure with smooth skin covering. All-metal slotted ailerons and flaps. Total flap area 2.18 m.² (23.6 sq. ft.). Total aileron area 1.52 m.² (16.4 sq. ft.). Gross wing area 18.81 m.² (203 sq. ft.).

FUSELAGE.—Oval section all-metal monocoque.

TAIL UNIT.—Cantilever monoplane type. Aluminium-alloy riveted structure. Fin area 0.66 m.² (7.1 sq. ft.). Rudder area 0.84 m.² (9 sq. ft.). Tailplane area 2.02 m.² (21.7 sq. ft.). Total elevator area 1.52 m.² (16.4 sq. ft.).

LANDING GEAR.—Retractable nose-wheel type. Electric retraction, with emergency manual operation. Oleo-pneumatic shock-absorbers. Hydraulic wheel brakes. Track 3.15 m. (10 ft. 4 in.). Wheelbase 2.03 m. (6 ft. 8 in.).

POWER PLANT.—One 270 h.p. Lycoming GO-480 six-cylinder horizontally-opposed geared air-cooled engine. Piaggio P.1034 three-blade constant-speed airscrew. Four fuel tanks in wings. Total fuel capacity 240 litres (52.8 Imp. gallons = 63.4 U.S. gallons). Oil capacity 11.3 litres (2.5 Imp. gallons = 3.0 U.S. gallons).



The Piaggio P.149 (270 h.p. Lycoming GO-480 engine).

ACCOMMODATION.—Enclosed cabin containing two front seats with dual controls and a wide rear seat for 2-3 persons. Canopy slides backward for access and can be released in flight for emergency exit when the aircraft is used for aerobatics. Large baggage compartment behind rear seat. Complete blind-flying and navigation instrumentation, including radio and D/F.

DIMENSIONS.—
Span 11.12 m. (36 ft. 6 in.).
Length 8.80 m. (28 ft. 9½ in.).
Height 2.90 m. (9 ft. 6 in.).

WEIGHTS AND LOADINGS.—
Weight empty 1,160 kg. (2,557 lb.).
Disposable load 520 kg. (1,147 lb.).
Weight loaded 1,680 kg. (3,704 lb.).
Wing loading 89.3 kg./m.² (18.2 lb./sq. ft.).
Power loading 6.20 kg./h.p. (13.7 lb./h.p.).

PERFORMANCE.—
Max. speed at S/L. 304 km.h. (192 m.p.h.).
Max. speed at 2,000 m. (6,560 ft.) 285 km.h. (177 m.p.h.).
Cruising speed at 2,300 m. (7,500 ft.). at 67% METO power 266 km.h. (165 m.p.h.).
Stalling speed at S/L. (with flaps) 92 km.h. (57 m.p.h.).
Initial rate of climb 300 m./min. (980 ft./min.).
Service ceiling 6,050 m. (19,800 ft.).
Range (including allowance for starting, warm-up, take-off and climb, plus ½ hour reserve) at 3,300 m. (10,800 ft.) and with full tanks 1,090 km. (680 miles).
Take-off run (no wind) to clear 15 m. (50 ft.) 405 m. (1,328 ft.).
Landing run (no wind) from 15 m. (50 ft.) 315 m. (1,033 ft.).

THE PIAGGIO P.136-L-1 and L-2.

In production for the Italian Air Force as an air/sea rescue amphibian, the P.136 is now available in two forms, the P.136-L-1 and P.136-L-2, which differ only in their power plants. Both are being marketed in the American continent by the Trecker Aircraft Corporation as the Trecker Gull.

The original P.136-L version is no longer in production, but has been described in earlier editions of this work.

TYPE.—Twin-engined Five-seat Amphibian Flying-boat.

WINGS.—High-wing gull-shaped cantilever monoplane. NACA 230 wing section. Aspect ratio 7.4. Dihedral 21° 30′ inner gull portion, 2° 5′ outer wing. Chord 2.40 m. (7 ft. 10½ in.) root, 1.15 m. (3 ft. 9¼ in.) tip. All-metal aluminium-alloy riveted structure. Single-spar box type, smooth skin covering. All-metal slotted trailing-edge flaps. Metal-framed fabric-covered slotted ailerons. Total flap area 2.38 m.² (25.6 sq. ft.). Total aileron area 1.95 m.² (21 sq. ft.). Gross wing area 25.1 m.² (270.2 sq. ft.).



The Piaggio P.136-L-1 Amphibian (two 270 h.p. Lycoming GO-480-B engines).

HULL.—Two-step type. All-metal plated aluminium-alloy riveted semi-monocoque structure. Side floats attached to wing by single streamline strut. Retractable water rudder.

TAIL UNIT.—Cantilever monoplane type. All-metal plated aluminium-alloy riveted structure. Tailplane and fin covered with smooth metal skin. Elevators and rudder fabric-covered. Trimming tabs in elevators and rudder. Fin area 1.81 m.² (19.5 sq. ft.), rudder area 0.77 m.² (8.3 sq. ft.), total elevator area 2.55 m.² (27.4 sq. ft.), tailplane area 2.82 m.² (30.5 sq. ft.).

LANDING GEAR.—Retractable type. Hydraulically operated. Oleo-pneumatic shock absorbers. Hydraulic wheel brakes. Track 2.54 m. (8 ft. 4 in.). Wheelbase 5.72 m. (18 ft. 9 in.).

POWER PLANT (P.136-L-1).—Two 270 h.p. Lycoming GO-480-B geared engines. Three-blade Piaggio P.1033 or Hartzell HC-83X20-2AL constant-speed full-feathering airscrews. Two fuel tanks in hull with total capacity of 720 litres (158.4 Imp. gallons= 190.3 U.S. gallons).

POWER PLANT (P.136-L-2).—Two 340 h.p. Lycoming GSO-480 geared and supercharged engines. Otherwise as P-136-L-1.

ACCOMMODATION.—Enclosed cabin seating two side-by-side in front and three on large seat aft. Dual controls. Two side doors. Right-hand panel of windshield fully openable for mooring, etc.

DIMENSIONS.—
Span 13.53 m. (44 ft. 4.7 in.).
Length overall 10.80 m. (35 ft. 5 in.).
Height overall 3.83 m. (12 ft. 7 in.).

WEIGHTS AND LOADINGS (P.136-L-1).—
Weight empty 1,996 kg. (4,400 lb.).
Disposable load 724 kg. (1,596 lb.).
Weight loaded 2,720 kg. (5,996 lb.).
Wing loading 108.5 kg./m.² (22.2 lb./sq. ft.).
Power loading, take-off, 5.04 kg./h.p. (11.1 lb./h.p.).

WEIGHTS AND LOADINGS (P.136-L-2).—
Weight empty 2,110 kg. (4,652 lb.).
Disposable load 884 kg. (1,948 lb.).
Weight loaded 2,994 kg. (6,600 lb.).
Wing loading 119.3 kg./m.² (24.4 lb./sq. ft.).
Power loading, take-off, 4.4 kg./h.p. (9.7 lb./h.p.).

PERFORMANCE (P.136-L-1 at 2,720 kg.=5,996 lb. gross weight).—
Max. speed at S/L 294 km.h. (182.7 m.p.h.).
Cruising speed (70% rated power) 268 km.h. (167 m.p.h.) at 2,800 m. (9,000 ft.).
Stalling speed (with flaps) 110 km.h. (68.4 m.p.h.).
Service ceiling 6,000 m. (19,685 ft.).
Service ceiling (one engine) 1,500 m. (5,000 ft.).
Range (payload 355 kg.=783 lb.) 950 km. (590 miles).
Max. range (55% rated power, full tanks) 1,700 km. (1,056 miles).

PERFORMANCE (P.136-L-2 at 2,994 kg.=6,600 lb. gross weight).—
Max. speed at S/L. 335 km.h. (208 m.p.h.).
Cruising speed (70% rated power) at 4,100 m. (13,500 ft.) 306 km.h. (190 m.p.h.).
Stalling speed (with flaps) 116 km.h. (72 m.p.h.).
Service ceiling 7,800 m. (25,500 ft.).
Service ceiling (one engine) 3,600 m. (11,800 ft.).
Range (50% power) at 4,300 m. (14,000 ft.) 1,450 km. (900 miles).



The Piaggio P.136-L-2 Amphibian (two 340 h.p. Lycoming GSO-480 engines).

SIAI-MARCHETTI

SOCIETÀ PER AZIONI SIAI-MARCHETTI.

REGISTERED OFFICE: VIA DELLA POSTA, 3, MILAN.

MANAGEMENT AND WORKS: SESTO CALENDE (VARESE).

AERODROME: VERGIATE (VARESE).

ROME OFFICE: VIA PUCCINI, 10.

The Siai-Marchetti company, formerly known as Savoia-Marchetti, has produced a wide range of military and civil aircraft covering both landplanes and flying-boats.

Its latest product is the Eolo 3V-1 sailplane, of which a brief description is given hereafter. The company is also overhauling and repairing various types of aircraft for the Italian Air Force and other countries.

THE EOLO 3V-1.

The Eolo 3V-1 high-performance sailplane was designed by Eng. Bruni and



The Eolo 3V-1 High-performance Sailplane built by SIAI-Marchetti.

built by SIAI-Marchetti in co-operation with the Alessandro Passaleva Soaring Sports Club of Vergiate. It made its first flight in August, 1953, and has since been flown with considerable success.

TYPE. High-performance Sailplane.

WINGS.—Mid-wing cantilever monoplane. Laminar flow section with maximum thickness at approximately 50% chord. Aspect ratio 25. All-wood single-spar structure with very thick plywood covering and wing-tip "salmons." Inner portions of ailerons droop with the slotted high-lift flaps. Spoilers, made up of 32 blades, retract into slots above and below wing aft of main spar. Provision for 32 kg. (70 lb.) of water ballast in inboard leading-edge. Wing area 16.0 m.² (172 sq. ft.).

FUSELAGE.—Elliptical semi-monocoque wood structure.

TAIL UNIT.—"Butterfly" type with tailplane and elevators set at acute angle.

LANDING GEAR.—Fully retractable single-wheel type, with brake. Small skid on nose. Small sprung tail-skid.

ACCOMMODATION.—Pilot seated under one-piece low-drag transparent canopy. Full instrumentation. Adjustable seat and foot-rests.

DIMENSIONS.—
Span 20.0 m. (65 ft. 7 in.).
Length 8.5 m. (27 ft. 11 in.).

WEIGHTS.—
Weight empty 329 kg. (726 lb.).
Weight loaded 450 kg. (992 lb.).
Wing loading 28.07 kg./m.² (5.75 lb./sq. ft.).

PERFORMANCE.—
Min. sinking speed at 92 km.h. (57 m.p.h.) 0.80 m./sec. (2.6 ft./sec.).
Max. permissible speed 200 km.h. (125 m.p.h.).
Max. permissible speed with air-brakes extended 160 km.h. (99.5 m.p.h.).
Landing speed 41 km.h. (25.5 m.p.h.).
Towing speed 100-130 km.h. (62-81 m.p.h.).

JAPAN

FUJI

FUJI JUKOGYO KABUSHIKI KAISHA. (Fuji Heavy Industries Ltd.).

HEAD OFFICE: No. 18, 2-CHOME, MARUNOUCHI, CHIYODA-KU, TOKYO.

AIRCRAFT FACTORY: UTSUNOMIYA CITY, TOCHIGI PREFECTURE.

AERO-ENGINE FACTORIES: MITAKA, TOKYO; OMIYA CITY, SAITAMA PREFECTURE.

President and Director: Takao Yoshida.

Chairman: Kijio Kishi.

Managing Directors: Tadashi Miki, Toshio Inoue, Tomizo Fujiu, Takeo Kotani and Toshio Matsubayashi.

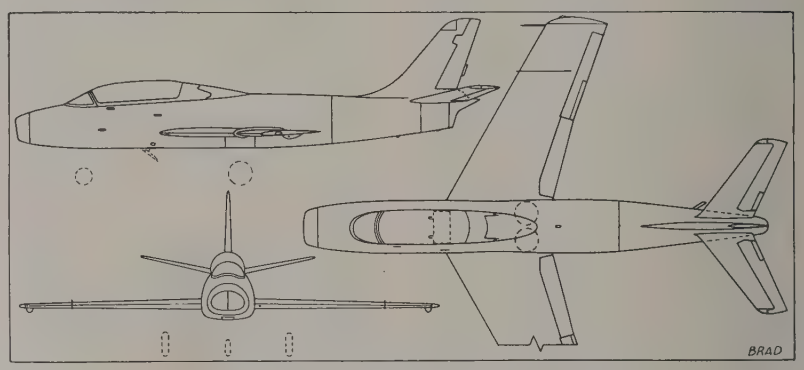
Fuji Heavy Industries Ltd. was established on July 15, 1953, and is essentially a successor to the Nakajima Aircraft Company, a pioneer in the field of aviation in Japan, established in 1914.

Under a licence and technical assistance agreement with the Beech Aircraft Corporation, concluded in 1953, Fuji is building the Beechcraft Mentor at the Utsunomiya plant for the Japan Air Self-Defence Force. Beginning deliveries in August, 1954, Fuji now has a production capacity of 12 Mentors per month. Exports of this aircraft to the air forces of various Asian countries are anticipated.

Fuji is also developing a new version of the Mentor with a more powerful engine.

A modified version of the Mentor with both military and civil uses has been developed as the LM-1 Nikko, and this aircraft is now in quantity production for liaison duties with the Japan Ground Self-Defence Force. The prototype of a more powerful version of this aircraft, the LM-II Supernikko, was scheduled to fly during 1958.

Fuji also has a licence agreement with Cessna Aircraft Company under which it is building the Cessna L-19 observation aircraft in Japan. Initial deliveries to the Ground Self-Defence Force were made in December, 1957.



The Fuji T1F2 Two-seat Jet Trainer.

First aircraft designed entirely by Fuji is the T1F2 swept-wing intermediate two-seat jet trainer, of which two prototypes have been built.

THE FUJI T1F2.

The T1F is a tandem two-seat jet training aircraft which was designed to meet a Japanese Defence Agency requirement for a replacement for the North American T-6G basic trainer. Three versions have been announced, as follows:—

T1F1. Projected version with Nippon J3-1 turbojet engine (1,200 kg.=2,645 lb. s.t.).

T1F2. Two prototypes for evaluation with Bristol Orpheus BOr.1 turbojet (1,837 kg.=4,050 lb. s.t.).

T1F3. Production version with Bristol Orpheus BOr.4 turbojet (1,919 kg.=4,230 lb. s.t.).

The initial contract covered the manufacture of two flying prototypes of the T1F2 and one airframe for structure testing. The first prototype flew on January 19, 1958, followed by the second in February, 1958. After initial flight testing by Fuji, both of these prototypes were delivered to the Japanese Defence Agency in March, 1958, for evaluation and operational trials.

Present plans call for a follow-up contract for four more Orpheus-powered aircraft in fiscal 1958 and the initiation of quantity production in 1959.

The following description applies specifically to the T1F2.

TYPE.—Intermediate Jet trainer.

WINGS.—Cantilever low-wing monoplane. K-561/K-569 wing section. Aspect ratio 4.96. Chord at root 2.867 m. (9 ft. 5 in.), at tip 1.502 m. (4 ft. 11 in.). Dihedral 1° 50'. Sweepback 26.7° at 25% chord. All-metal stressed-skin structure. Aluminium-alloy ailerons and high-lift flaps. Total area of ailerons 1.38 m.² (14.85 sq. ft.). Total area of flaps 2.52 m.² (27.13 sq. ft.). Gross wing area 22.22 m.² (239.2 sq. ft.).

FUSELAGE.—All-metal stressed-skin semi-monocoque structure.



The Fuji T1F2 Two-seat Trainer (Bristol Orpheus turbojet engine).

TAIL UNIT.—Cantilever monoplane type. All-metal stressed-skin structure. Areas: fin 1.98 m.² (21.31 sq. ft.), rudder 0.69 m.² (7.43 sq. ft.), tailplane 3.77 m.² (40.58 sq. ft.), elevators 1.04 m.² (11.20 sq. ft.). Tailplane span 4.4 m. (14 ft. 5 in.).

LANDING GEAR.—Retractable tricycle type. Oleo shock-absorbers. Hydraulic retraction. Wheel track 3.20 m. (10 ft. 6 in.). Wheelbase 3.86 m. (12 ft. 8 in.).

POWER PLANT.—One Bristol Orpheus BOr.1 turbojet engine (1,837 kg.=4,050 lb. s.t.). Total fuel capacity 1,400 litres (308 Imp. gallons).

ACCOMMODATION.—Crew of two in tandem in pressurised and air-conditioned cabin. Ejection seats. Oxygen system. Complete dual controls and instrumentation.

DIMENSIONS.—
Span 12.12 m. (39 ft. 9 in.).
Length 10.50 m. (34 ft. 5 in.).
Height 4.03 m. (13 ft. 3 in.).

WEIGHT.—
Design loaded weight approx. 3,600 kg. (7,937 lb.).

PERFORMANCE.—
Limiting Mach No. 0.85.

THE FUJI MODEL LM-11 SUPERNIKKO.

The Supernikko is a more powerful version of the LM-1 Nikko with full instrumentation and navigation equipment for blind flying. It is intended for both civil and military use. A prototype was scheduled to fly during 1958.

TYPE.—Four-seat General Purpose monoplane.

WINGS, FUSELAGE, TAIL UNIT AND LANDING GEAR.—Same as for LM-1 Nikko.

POWER PLANT.—One 340 h.p. Lycoming GSO-480-B1A6 six-cylinder horizontally-opposed air-cooled supercharged engine, driving a Hartzell type HC-83X20-1B/9333C-3 three-blade constant-speed airscrew. Fuel in two bladder-type tanks in wings with total capacity of 189 litres (41.5 Imp. gallons). Provision for two auxiliary fuel tanks in wings, each with capacity of 38 litres (8.4 Imp. gallons). Oil capacity 11.4 litres (2.5 Imp. gallons).

ACCOMMODATION.—Same as for LM-1 Nikko, except that oxygen equipment is standard. Normally seats four persons, but five can be accommodated if required.

DIMENSIONS.—
Same as for LM-1 Nikko.

WEIGHTS AND LOADINGS.
Weight empty 1,121 kg. (2,472 lb.).
Weight loaded 1,600 kg. (3,528 lb.).
Wing loading 97.0 kg./m.² (19.9 lb./sq. ft.).
Power loading 4.70 kg./h.p. (10.4 lb./h.p.).

PERFORMANCE (estimated).—
Max. speed at 2,440 m. (8,000 ft.) 360 km.h. (224 m.p.h.).
Stalling speed (flaps down) 89 km.h. (55 m.p.h.).
Rate of climb at S/L 424 m./min. (1,390 ft./min.).
Rate of climb at 2,440 m. (8,000 ft.) 410 m./min. (1,350 ft./min.).



The Fuji LM-1 Nikko (225 h.p. Continental O-470 engine).

Time to 3,000 m. (9,840 ft.) 7.35 min.
Service ceiling 7,600 m. (25,000 ft.).
Take-off distance 262 m. (860 ft.).
Take-off distance to 15 m. (50 ft.) 370 m. (1,215 ft.).
Landing distance 237 m. (778 ft.).
Landing distance from 15 m. (50 ft.) 395 m. (1,300 ft.).
Range at 50% power (271 km.h.=168 m.p.h.) at 3,000 m. (9,840 ft.) 1,135 km. (705 miles).
Range at 60% power (300 km.h.=186 m.p.h.) at 3,000 m. (9,840 ft.) 1,030 km. (640 miles).

THE FUJI MODEL LM-1 NIKKO.

Freely adapted from the Beech Model B-45 Mentor airframe, the Model LM-1 Nikko differs only in interior modifications, including accommodation for four to five and an extra wing fuel tank of 10 U.S. gallons (38 litres). Dispensing with additional military training equipment has resulted in lower empty weight and increased payload and gross loaded weight.

Delivery of 27 Nikko liaison aircraft and components ordered under U.S. off-shore procurement for the Japanese Ground Self-Defence Force has been completed.

TYPE.—Four to five seat general-purpose single-engine Cabin Monoplane.

WINGS.—As Model B-45 Mentor.

FUSELAGE.—As Model B-45 Mentor except for modifications listed under "Accommodation."

TAIL UNIT AND LANDING GEAR.—As Model B-45 Mentor.

POWER PLANT.—As Model B-45 Mentor. Additional to the two B-45 wing tanks of 25 U.S. gallons each (total 190 litres) is a third wing tank of 10 U.S. gallons (38 litres).

ACCOMMODATION.—Enclosed cabin seating a maximum of five; pilot in front on port side with conventional wheel control system, and three passengers, one beside the pilot and two side-by-side at back of cabin. An additional auxiliary seat may be installed between the front and rear main seats. Maximum interior width of cabin 1.04 m. (41 in.) as against the 0.914 m. (36 in.) of the Model B-45 Mentor. Access door on the starboard side. Rear windows open for ground ventilation. Cabin structure is reinforced for protection against turn-overs. A large portion of the roof structure is easily removable for access to the cabin when loading bulky cargoes. Provisions have been incorporated in the design for the LM-1 to be quickly adapted for photographic survey, ambulance and light cargo duties. Complete side-by-side dual controls can also be provided.

DIMENSIONS (As Model B-45 Mentor).

WEIGHTS AND LOADINGS.—
Weight empty (full equipped) 945 kg. (2,080 lb.).
Useful load 525 kg. (1,165 lb.).
Useful load (max.) 655 kg. (1,447 lb.).
Weight loaded (normal) 1,470 kg. (3,245 lb.).
Weight loaded (max.) 1,600 kg. (3,527 lb.).
Wing loading 89.1 kg.m.² (18.26 lb./sq. ft.).
Power loading (fully loaded) 6.54 kg./h.p. (14.4 lb./h.p.).

PERFORMANCE (Gross weight 1,470 kg.).—
Max. speed at S/L. 297 km.h. (185 m.p.h.).
Cruising speed 239 km.h. (148 m.p.h.) at 910 m. (3,000 ft.).
Stalling speed (flaps down) 85 km.h. (53 m.p.h.).
Rate of climb at S/L. 302 m./min. (990 ft./min.).
Time to 1,525 m. (5,000 ft.) 6 min.
Time to 3,050 m. (10,000 ft.) 15 min. 45 sec.
Service ceiling 4,575 m. (15,000 ft.).
Take-off run 178 m. (584 ft.).
Take-off distance to clear 15 m. (50 ft.) 501 m. (1,642 ft.).
Landing run 164 m. (538 ft.).
Landing distance from 15 m. (50 ft.) 339 m. (1,110 ft.).
Cruising range 1,440 km. (895 miles) at 910 m. (3,000 ft.).

KAWASAKI

KAWASAKI KOKUKI KOGYO KABUSHIKI KAISHA (Kawasaki Aircraft Co., Ltd.).

HEAD OFFICE: 38, AKASHI-MACHI, IKUTA-KU, KOBE.

WORKS: GIFU AND AKASHI.

The former Kawasaki Kikai Kogyo Kabushiki Kaisha and Kabushiki Kaisha Kawasaki Gifu Seisakusho were amalgamated under the name Kawasaki Kokuki Kogyo Kabushiki Kaisha (Kawasaki Aircraft Co., Ltd.) on March 15, 1954.

Kawasaki has contracts with the Lockheed Aircraft Service (Overseas) permitting it to repair, overhaul and manufacture the Lockheed T-33A trainer and the P2V Neptune. Kawasaki is assembling 180 T-33A's for the Japanese Self-Defence Air Forces. The first of these flew in January, 1956. In 1958 the manufacture of the Lockheed P2V-7 Neptune anti-submarine aircraft was begun for the Japanese Navy.

Kawasaki has assembled more than 60 Bell Model 47 helicopters, and it has also undertaken the manufacture of aircraft of original design. Its first post-war products, the KAL-2 and KAT-1, have been described and illustrated in previous editions of this Annual.

MITSUBISHI

SHIN MITSUBISHI JUKOGYO KABUSHIKI KAISHA (Mitsubishi Heavy-Industries, Reorganized, Ltd.).

HEAD OFFICE: No. 1, 7-CHOME, WADAMIYA-DORI, HYOGO-KU, KOBE.

AIRCRAFT DEPARTMENT HEAD OFFICE: No. 14, 2-CHOME, MARUNOUCHI, CHIYODA, TOKYO.

President: Shinzo Fujii.

Vice-President: Taizo Shoda.

Manager, Aircraft Department: Iwataro Nakagawa.

Mitsubishi began the production of aircraft in the present Oye plant of its Nagoya Engineering Works in 1920, and manufactured a total of 80,000 aircraft of approximately one hundred different types during the 25 years prior to the termination of World War II in 1945.

The company was also one of the most outstanding aero-engine manufacturers in Japan, and produced a large number of engines in the 1,000-2,500 h.p. range.

The conclusion of the Peace Treaty in 1952 enabled the aircraft industry in Japan to recommence, and in December of that year the company constructed its present Komaki aircraft plant, which has a total area of 3,060,000 square feet, and building area of 288,000 square feet. The overhaul of F-86 fighters for the United States Far East Air Forces was started in March, 1953.

The Komaki Plant is also carrying out the overhaul and repair of Sikorsky S-55 helicopters for the Japanese Defence Agency and others, under a technical assistance agreement for parts manufacture and repair concluded with the United Aircraft Corporation, Sikorsky Aircraft Division.

The construction of an Aero-engine Overhaul Shop in the Daiko Plant was completed in the Spring of 1952, and over 250 engines have already been overhauled for the Japan Air Lines, Northwest Air Lines, Japanese Defence Agency, and other domestic and overseas clients. This work is being done under a technical assistance agreement on parts production

and repair concluded with the United Aircraft Corporation, Pratt & Whitney Aircraft Division.

Following the conclusion of an agreement between the United States and the Japanese Governments in June, 1955, for the manufacture in Japan of jet aircraft, the company is assembling a total of 300 F-86F fighters, under a complete licence agreement with North American Aviation Inc. This work is being carried out in the company's Komaki and Oye plants and involves the manufacture of some 77% of the airframe components, the remainder being supplied by the parent company. The first aircraft of this programme was flown on August 9, 1956.

Mitsubishi is also engaged on the development of guided weapons.

SHOWA

SHOWA HIKOKI KOGYO KABUSHIKI KAISHA (Showa Aircraft Industry Co., Ltd.).

HEAD OFFICE: No. 1, 2-CHOME, NIHONBASHI - MUROMACHI, CHUO - KU, TOKYO.

WORKS: No. 600, TANAKA-MACHI, AKISHIMA-CITY, TOKYO, AND No. 898, OHGAMI-MACHI, AKISHIMA-CITY, TOKYO.

President: Kanoh Hironaka.

Executive Director: Shinji Iwabuchi.

Managing Directors: Kiyoshi Maekawa and Masayoshi Hashimoto.

Showa, which, before the war, was responsible for the manufacture of the Douglas DC-3 under licence, was the first Japanese aircraft manufacturing company to resume post-war operations when it undertook the overhaul and repair of aircraft of the Far East Air Force under contract with the U.S. Government.

While continuing with the overhaul and repair of U.S.A.F. aircraft, helicopters and aero-engines, the company is also participating in the Japanese Government's project to develop a medium-range transport aircraft, by undertaking a programme of structural strength research.

TACHIKAWA

SHIN TACHIKAWA KOKUKI KABUSHIKI KAISHA (New Tachikawa Aircraft Co., Ltd.).

HEAD OFFICE: 1-100 TAKAMATSU-CHO, TACHIKAWA, TOKYO.

FACTORIES: TACHIKAWA AND SUNAGAWA.

President: Yoshio Kawasaki.

Chief Engineer: Shigeru Motoo.

The New Tachikawa Aircraft Company was established on November 15, 1949, as the second reconstructed company of the former Tachikawa Aircraft Co., Ltd.

As all the factory area of the former company has been in use by the U.S. Air Force since September 4, 1945, Tachikawa has built a new factory at Sunagawa, outside the original factory area.

As soon as the Air Law permitting the manufacture of aircraft was published on July 15, 1952, the company began the design of its first aeroplane, the R-52. This was completed in September, 1952 and was the first aircraft built entirely of Japanese materials and powered by a Japanese engine to be completed since the war.

A revised version, the R-53, has since been built and is described hereunder.



The Tachihi R-53 (155 h.p. Blackburn Cirrus Major engine).

THE TACHIHI R-53.

TYPE.—Two-seat Trainer.

WINGS.—High-wing strut-braced monoplane. NACA 23012 wing section. Aspect ratio 6.62. Dihedral nil. Two Japanese cypress spars, pressed duralumin ribs and fabric covering. No flaps or slots. Gross wing area 17.3 m.² (186 sq. ft.).

FUSELAGE.—Welded steel tube structure covered with fabric.

TAIL UNIT.—Strut-braced monoplane type. Welded steel tube framework with fabric covering. Trim-tab in elevator. Areas: fin 0.7 m.² (7.54 sq. ft.), rudder 1.03 m.² (11.09 sq. ft.), horizontal tail area 2.5 m.² (26.9 sq. ft.). Tailplane span 3.376 m. (11 ft.).

LANDING GEAR.—Fixed tail-wheel type. Oil spring shock-absorber struts. Wheel brakes. Steerable tail-wheel with spring steel shock-absorber.

POWER PLANT.—One 155 h.p. Blackburn Cirrus Major four-cylinder in-line inverted air-cooled engine. Two-blade fixed-pitch wood airscrew 2.04 m. (6 ft. 8 in.) diameter. Fuel tank (140 litres=30.8 Imp. gallons) in centre-section of wing.

ACCOMMODATION. — Tandem open cockpits with dual controls.

DIMENSIONS.—
Span 10.7 m. (35 ft. 1 in.).
Length 7.55 m. (24 ft. 9 in.).
Height 2.65 m. (8 ft. 8 in.).

WEIGHTS.—
Weight empty 668 kg. (1,473 lb.).
Disposable load 282 kg. (622 lb.).
Weight loaded 950 kg. (2,095 lb.).

PERFORMANCE.—
Max. speed 208 km.h. (129 m.p.h.).
Cruising speed 145 km.h. (90 m.p.h.).
Stalling speed 79 km.h. (49 m.p.h.).
Service ceiling 4,350 m. (14,270 ft.).
Range 750 km. (466 miles).
T.O. distance to 15 m. (50 ft.) 421 m. (461 yds.).
Landing distance from 15 m. (50 ft.) 466 m. (510 yds.).

TOYO

TOYO KOKU KABUSHIKI KAISHA (Toyo Aircraft Industry Company Ltd.).

HEAD OFFICE: 9 RAPPONGI, AZABU, MINATO-KU, TOKYO.

WORKS: TOFSUKA, YOKOHAMA.

ASSEMBLY SHOP AND AIRSTRIP: OHARA, FUJISAWA, KANAGAWA PREFECTURE.

President: Shigemi Yokoo.

Vice-President and Managing Director: Shingo Ishikawa.

Director of Technical Services and Chief Engineer: Yoshio Hashiguchi.

The Toyo Aircraft Manufacturing Company was formed on June 10, 1952, by Shigemi Yokoo, a former Minister of International Trade and Industry; Shingo Ishikawa, a former admiral of the Imperial Japanese Navy; and Yoshio Hashiguchi, who was formerly managing director and chief engineer of the Kawasaki Aircraft Company.

The company's first aircraft, the Type TT-10, made its first flight on December 30, 1952. This aircraft has been described and illustrated in previous issues of this Annual.

Toyo holds the manufacturing and sales licences for the FD-25 and FD-25A from the Fletcher Aviation Corporation of Pasadena, California, U.S.A.

In addition to building complete aircraft Toyo is engaged in general aircraft overhaul and maintenance work.

NETHERLANDS

AVIOLANDA

AVIOLANDA MAATSCHAPPIJ VOOR VLIEGTUIGBOUW N.V.

HEAD OFFICE: VEERDAM, PAPENDRECHT.

WORKS: PAPENDRECHT, DORDRECHT AND WOENSDRECHT.

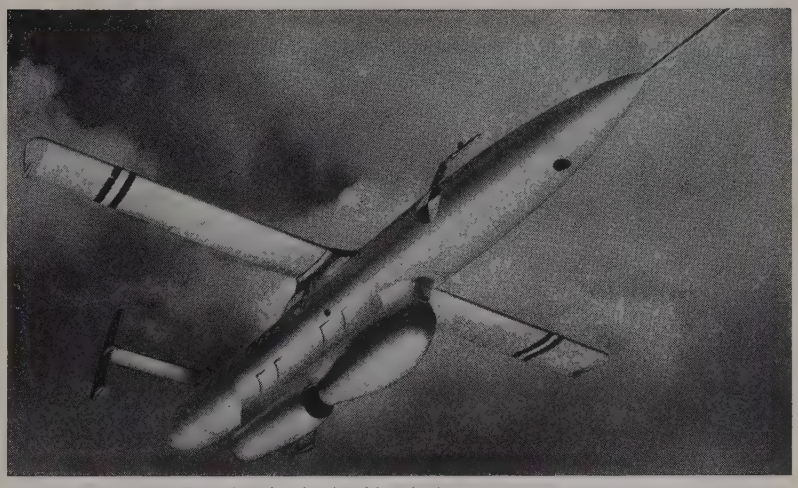
Managers: H. A. Burgerhout; J. Goedkoop Dzn.

Assistant Managers: D. van Leeuwen; J. A. de Vries, M.Sc.

Founded in 1927 by the late Mr. H. Adolph Burgerhout, this company built Dornier flying-boats and Curtiss Hawk fighters under licence pre-war. Its present activities include production of components for the Hawker Hunter and the NHI Kolibrie helicopter, and development of the AT-21 pilotless electronically-controlled drone aircraft.

Exclusive licence rights to manufacture the SNECMA pulse-jet engine used in the AT-21 drone are also held by the company.

Aviolanda is also engaged on extensive overhaul and repair work. Military contracts cover the overhaul and repair of Lockheed Neptune and T-33, North American F-86K, Grumman Avenger, Hiller H-23 and Sikorsky S-55 aircraft. Civil work includes the conversion and re-skinning of Douglas DC-6 transports.



The Aviolanda AT-21 Pilotless Target Drone.

THE AVIOLANDA AT-21 DRONE.

The AT-21 is a pilotless, electronically-controlled aircraft for tactical photographic-reconnaissance, radar training, liaison and gunnery practice. It was designed at the Aviolanda works at Papendrecht and is the first aircraft of its type produced in the Netherlands.

It is ramp-launched with the assistance of booster rockets and controlled in flight from a ground station which contains standard aircraft controls and a cathode-ray tube control panel. Data provided by a telemetry system in the missile and shown on this panel include airspeed, altitude, pitch, roll, incidence, yaw, distance, course and position.

Flight is terminated by actuating the parachute release mechanism. This automatically cuts off the fuel supply and the main electrical power supply and closes all cooling air inlets and exhausts.

After landing, the wing and tail surfaces can be released from the fuselage by explosive bolts. This makes salvage from the water much easier than if the aircraft had to be retrieved in one piece.

TYPE.—Pulse-jet Drone Aircraft.

WINGS.—High-wing cantilever monoplane. Constant chord plastic structure, filled with hard foam plastic. Wings keep afloat after a descent on the water. Metal ailerons. Detachable plastic wing-tips. Provision for wing-tip tanks. Wing area 1.44 m.² (15.5 sq. ft.).

FUSELAGE.—Four-piece structure of circular section. Plastic sandwich nose cone, followed by two light alloy cylindrical sections containing the fuel tank and landing parachutes, and a plastic tail cone.

TAIL UNIT.—Cantilever monoplane type with twin fins and rudders. Construction similar to wings.

POWER PLANT.—SNECMA Type AS.11 pulse-jet (45-70 kg. = 100-150 lb. s.t.) developed by SNECMA from their Ecrevisse unit. Mounted under the fuselage. Fuel capacity 120 litres (24 Imp. gallons).

EQUIPMENT.—Can be fitted with a camera, hit-recorder, markers, flares, etc.

DIMENSIONS.—
Span 3.60 m. (11 ft. 10 in.).
Length 5.50 m. (18 ft.).
Height 1.00 m. (3 ft. 3 in.).

WEIGHTS.—
Weight empty 155 kg. (340 lb.).
Weight loaded 300 kg. (660 lb.).

PERFORMANCE (estimated).—
Max. speed at S/L 330 km.h. (205 m.p.h.).
Max. speed at 3,000 m. (10,000 ft.) 346 km.h. (215 m.p.h.).
Cruising speed at 1,500-3,000 m. (5,000-10,000 ft.) 285 km.h. (177 m.p.h.).
Rate of climb at S/L 370 m./min. (1,200 ft./min.).
Rate of climb at 3,000 m. (10,000 ft.) 190 m./min. (620 ft./min.).
Endurance 60-70 min.

FOKKER

THE N.V. KONINKLIJKE NEDERLANDSE VLIEGTUIGENFABRIEK FOKKER (Royal Netherlands Aircraft Factories Fokker).

HEAD OFFICE AND MAIN FACTORY: SCHIPHOL-ZUID, AMSTERDAM.

OTHER FACTORIES: AMSTERDAM-NOORD, YPENBURG NEAR THE HAGUE, AND DORDRECHT.

Management: H. During, Prof. ir. E. van Emden, F. J. L. Diepen and ir. H. C. van Meerten.

The Fokker works at Amsterdam were founded in 1919 by the late A. H. G. Fokker, the well-known aircraft designer, who died on December 23, 1939.

After having rebuilt the war-damaged factory in the north of Amsterdam, a new factory was built in 1951 on the Schiphol Airport, where the main production takes place.

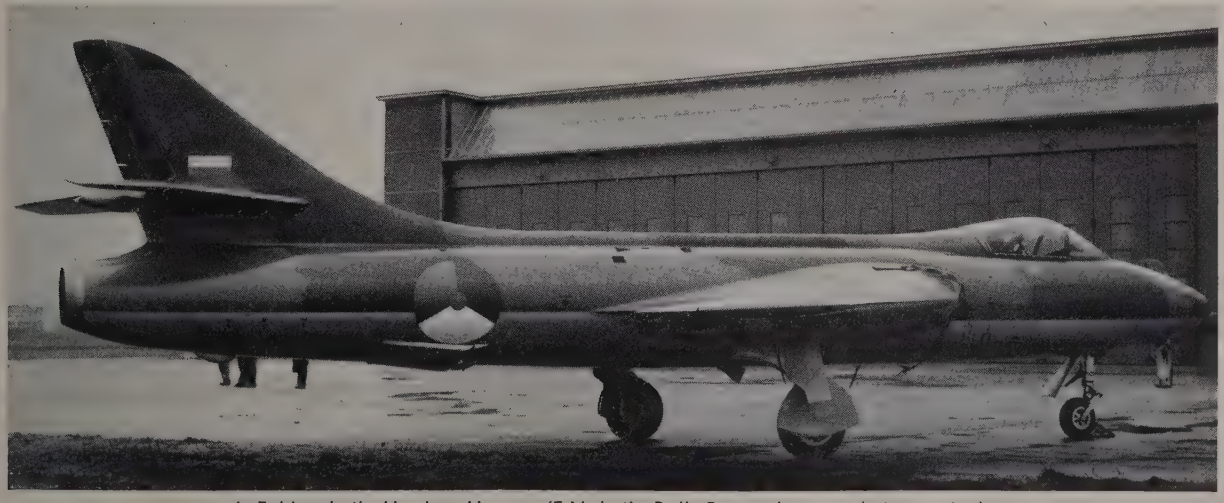
In 1954 the Fokker company enlarged its facilities by the acquisition of the Avio-Diepen Industrie Mij. N.V. at Ypenburg and the former Aviation Section of the "De Schelde" factory at Dordrecht.

Types of Fokker aircraft built since the war include the S.11 Instructor two-seat basic trainer; the S.12, a nose-wheel version of the S.11; the S.14 Mach-Trainer Mk. I two-seat transition jet trainer powered by a Rolls-Royce Derwent engine; and the S.14 Mach-Trainer Mk. II with the Rolls-Royce Nene engine.

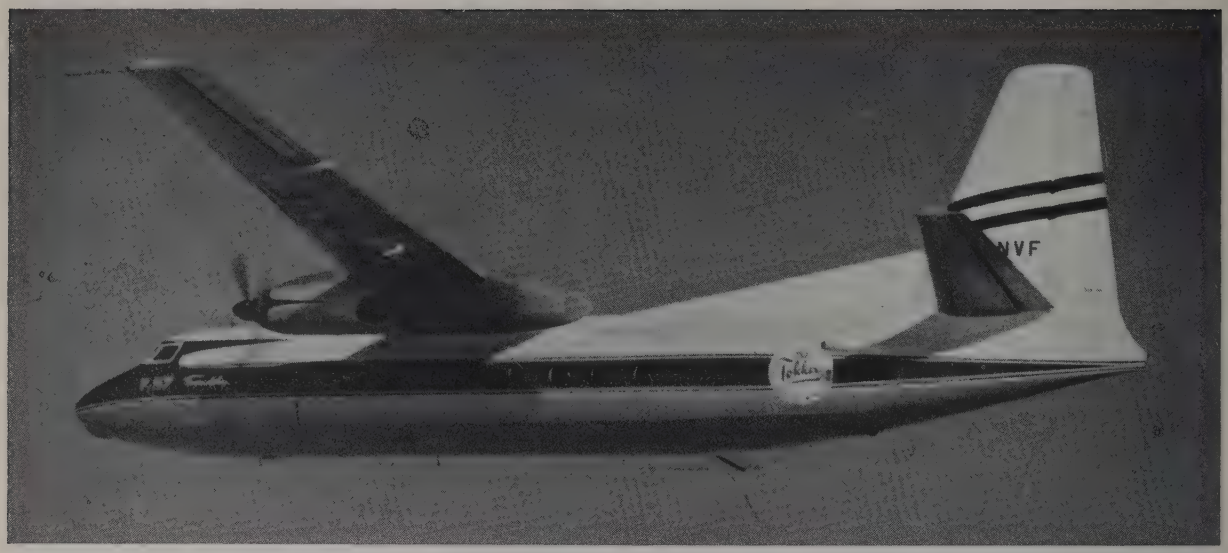
The S.11 Instructor is in service in the Netherlands, Israeli, Brazilian and Italian Air Forces. The Italian Macchi company built the Instructor under licence under the designation M.416.

In Brazil, Fokker Indústria Aéronautica S.A., with works at the Galeão Airport, Rio de Janeiro, is building a series of 100 S.11 Instructors for the Brazilian Air Force. It has also put into production the S.12 and the S.14 Mach-Trainer Mk. I, both in series of fifty.

Current production by Fokker in the



A Fokker-built Hawker Hunter (F.N.-built Rolls-Royce Avon turbojet engine).



The second prototype Fokker F.27 Friendship (two Rolls-Royce Dart turboprop engines).

Netherlands is concentrated largely on the F.27 Friendship twin-turboprop airliner, with first deliveries scheduled for 1958.

The Fairchild Engine and Airplane Corporation of Hagerstown, Maryland, U.S.A., is manufacturing the Friendship in quantity for the Western Hemisphere, with the exception of Brazil.

In addition, Fokker has signed agreements with the French Breguet and Belgian S.A.B.C.A. companies for mutual close co-operation in technical and commercial matters. S.A.B.C.A. is producing jigs and tools for Fokker, while Breguet, with Sud-Aviation, may produce Friendship components.

Under licence agreements, Fokker has built since the war a series of Hawker Sea Fury fighters for the Royal Netherlands Navy and 330 Gloster Meteor Mk. 8 fighters for the Netherlands and Belgian Air Forces.

In 1957 Fokker delivered 45 Hawker Hunters to the Royal Netherlands Air Force and 21 to the Belgian Air Force to complete these contracts.

THE FOKKER F.27 FRIENDSHIP.

The Friendship has been designed as a medium-sized airliner suitable for short to medium range continental traffic. Two prototypes have been built. The first made its first flight on November 24, 1955, and has accommodation for 28 passengers in a 22.3 m. (73 ft.) long fuselage. It was powered originally by two Rolls-Royce Dart 507 turboprops and later re-engined with Dart 511 turboprops. The second prototype, which flew on January 29, 1957, is representative of production aircraft, with Dart 511 engines, and seats 32 in a 23.1 m. (76 ft.) fuselage. Two further prototype airframes were built for structure testing.

Quantity production of the Friendship by both Fokker in the Netherlands and Fairchild in America has started, and the first Fokker-built aircraft for Aer Lingus was scheduled for delivery during 1958.

The production Friendship is a high-wing cantilever monoplane with standard seating for 32 passengers in a pressurised cabin. Backward-facing seats are optional. For short-range high-density traffic the number of seats may be increased to 36 or 40. The low floor level, large cargo holds and a removable front cabin wall make the Friendship well suited to those local services with many intermediate stops, where quick and simple loading and adaptation to ever-changing load demands are of importance.

The Friendship is powered initially by two 1,720 e.h.p. Rolls-Royce Dart RDa.6 Mk. 511 engines, but the more powerful Dart RDa.7 Mk. 528 will be introduced on Stage 2 Friendships at a future date.

In addition to the standard airliner version, there is an executive and V.I.P. transport version of the Friendship, of which several have already been ordered. There are also projected cargo and military transport versions, known as the Freightship and Troopship respectively.

At the time of writing the following orders for Fokker F.27's had been recorded: Aer Lingus (7), Ansett-ANA (6), Trans-Australia Airlines (12), Braathens SAFE (3), Trabajos Aereos Enlaces, Spain (3), Aviacion y Comercio, Spain (6), Netherlands Government (1), R.I.V., Turin (1), Australian Department of Civil Aviation (2), Iranian Oil (2), German commercial enterprise (1). In addition to the above, Fairchild-built F-27's have been ordered by West Coast Airlines (6), Mackey Airlines (2), Bonanza Airlines (6), Piedmont Airlines (8), Quebecair (2), Aerovias Ecuatorianas (1), Trans Pacific Airlines, Hawaii (3), Northern Consolidated (3), Pacific Airlines (5), Aerovias Venezolanas (5), Wien Alaska Airlines (3), Wheeler Airlines (2), Linea Aeropostal Venezolana (6), various U.S. Corporations (13). Negotiations with other airlines are proceeding. Including some options, a total of 140 F.27's are on order.

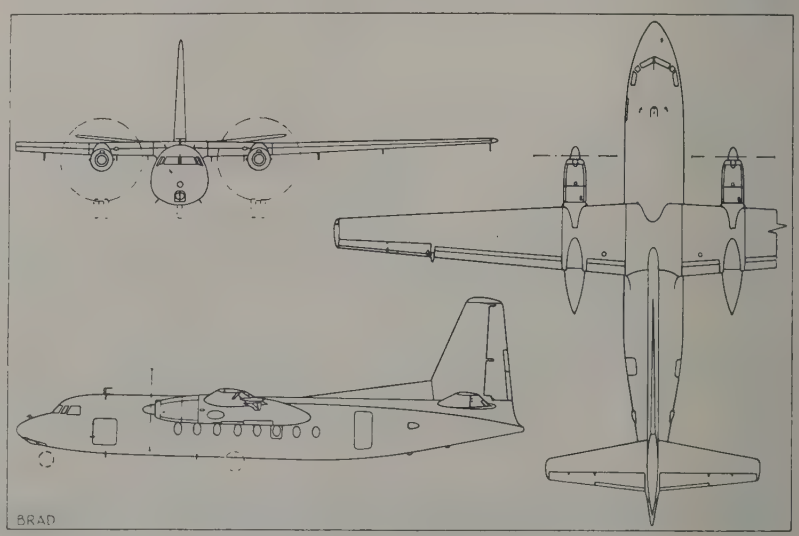
TYPE.—Twin turboprop-engined 32/40 passenger Airliner.

WINGS.—High-wing cantilever monoplane Wing section NACA 64-421 at root, 64-415 at tip. Aspect ratio 12. Taper ratio 0.4. Chord 3.45 m. (11 ft. 5 in.) at root, 1.4 m. (4 ft. 7 in.) at tip. All-metal riveted and metal-bonded two-spar stressed-skin structure consisting of centre-section and two detachable outer sections. Reinforced fiberglas leading and trailing edges, tips and fillets. Rubber-boot de-icers (thermal anti-icing through electric heat exchanger optional). Electrically-operated single-slotted flaps between ailerons and fuselage but divided by engine nacelles. Slotted ailerons. Gross wing area 70 m.² (754 sq. ft.).

FUSELAGE.—All-metal stressed-skin structure with cylindrical portions metal bonded and conical parts riveted. Between rear bulkhead of nose-wheel compartment and the circular pressure bulkhead aft of the luggage compartment the fuselage is pressurised to a differential of 4.16 lb./sq. in. (0.29 kg./cm.²). Length of pressurised section 16.16 m. (53 ft.). Diameter of fuselage 2.7 m. (8 ft. 10 in.). The slightly flattened fuselage bottom is reinforced by special under-floor members.

TAIL UNIT.—Cantilever monoplane type. All-metal stressed-skin structure. Fin and tailplane, as well as leading-edges of surfaces, are detachable. Rubber-boot de-icing (thermal anti-icing optional). Total area of vertical surfaces 14.2 m.² (150 sq. ft.), of horizontal surfaces 16.0 m.² (172 sq. ft.). Span of tail 9.8 m. (32 ft.).

LANDING GEAR.—Retractable tricycle type. Pneumatic retraction. Dowty oleo-pneumatic shock-absorber struts. All units of twin-wheel type. Main units retract backward into engine nacelles, nose unit forward into non-pressurised reinforced fiberglas nose cone. Pneumatic brakes on main wheels, which also have Dunlop Maxaret



The Fokker F.27 Friendship Airliner.



The second prototype Fokker F.27 Friendship (two Rolls-Royce Dart turboprop engines).

automatic anti-skid system. Wheelbase 8.48 m. (27 ft. 10 in.). Track of main units (between centre-lines of shock-absorbers) 7.20 m. (23 ft. 7½ in.).

POWER PLANT (Stage 1).—Two Rolls-Royce Dart Mk. 511 (RDa.6 rating) turboprop engines, each developing 1,600 s.h.p. plus 168 kg. (370 lb.) s.t. for take-off and a maximum continuous power of 1,460 s.h.p. plus 155 kg. (340 lb.) s.t. at 14,200 r.p.m. at sea level. Four-blade Rotol airscrews 3.66 m. (12 ft.) diameter. Integral fuel tanks in outer wings. Total fuel capacity 3,700 litres (814 Imp. gallons). Overwing fueling, but underwing system can be installed on request. Methylbromide fire-prevention system with flame detectors and crash-inertia switches.

POWER PLANT (Stage 2).—Two Rolls-Royce Dart Mk. 528 (RDa.7 rating) turboprop engines, each developing 1,800 s.h.p. plus 225 kg. (495 lb.) s.t. for take-off and a maximum continuous power of 1,555 s.h.p. plus 195 kg. (430 lb.) s.t. at 14,400 r.p.m. at sea level. Four-blade airscrews 3.50 m. (11 ft. 6 in.) diameter. These engines can be embodied in basic airframe without major structural alterations.

ACCOMMODATION (airliner).—Flight compartment seats two side-by-side. Main cabin has standard capacity for 40 first class passengers, but alternative arrangements allow this number to be increased to 44 by moving front cabin bulkhead. A further 4 seats can be added by moving rear cabin bulkhead and transferring pantry to forward cargo compartment. Pressurisation at 4.16 lb./sq. in. allows a cabin altitude of 2,440 m. (8,000 ft.) to be maintained up to a height of 6,100 m. (20,000 ft.). Air-conditioning and heating. Volume of forward cargo compartment 7.25 m.³ (255 cub. ft.) in standard version. Volume of rear baggage compartment 2.8 m.³ (100 cub. ft.) and 1.85 m.³ (66 cub. ft.) respectively. Entrance door, toilet, pantry and stewardess' seat aft of cabin, except in the high-density version where the pantry is located in forward cargo compartment.

ACCOMMODATION (executive and V.I.P. version).—Can be furnished to customer's specification, but a basic layout is available. In this, the cabin is divided into three sections: a conference room with six seats, a rest room with settee and divan, and a lounge with four seats. Toilet, galley, wardrobe, luggage space and seat for attendant in forward fuselage. Second toilet and luggage space at rear.

EQUIPMENT.—Pneumatic system for landing-gear retraction and brakes, with separate emergency system. Two separate electrical systems to provide power for flaps, anti-icing, radio, etc. Standard radio equipment includes VHF and HF receiver/transmitters, automatic D/F radio-compass, ILS and intercommunications system. 38.4 cub. ft. oxygen system available for pilots.

DIMENSIONS.—
Span 29.0 m. (95 ft. 2 in.).
Length 23.5 m. (77 ft. 2 in.).
Height 8.4 m. (27 ft. 6 in.).

WEIGHTS AND LOADINGS (40 passengers, Dart 511 engines).—
Basic operational weight 10,625 kg. (23,404 lb.).
Total fuel 4.015 kg. (8,844 lb.).
Max. payload 4,084 kg. (8,996 lb.).
Max. T.O. weight 16,208 kg. (35,700 lb.).
Max. landing weight 15,436 kg. (34,000 lb.).
Wing loading (max. T.O. wt.) 230.8 kg./m.² (47.3 lb/sq. ft.).
Wing loading (max. landing wt.) 220 kg./m.² (45.1 lb/sq. ft.).
Power loading (max. T.O. wt.) 5.04 kg./h.p. (11.1 lb./e.h.p.).

PERFORMANCE (at 14,970 kg. = 33,000 lb., Dart 511 engines).—
Cruising speed at 13,600 r.p.m. at 6,100 m. = 20,000 ft. 440 km.h. (275 m.p.h.).
Rate of climb at S/L 427 m/min. (1,400 ft./min.).
Max. rate of climb on one engine 122 m./min. (400 ft./min.).
Service ceiling on two engines 9,700 m. (31,800 ft.).
Service ceiling on one engine 4,270 m. (14,000 ft.).
Take-off field length on one engine 1,040 m. (3,410 ft.).
Take-off distance to clear 15.25 m. (50 ft.). 670 m. (2,200 ft.).
Landing-field length at S/L 997 m. (3,270 ft.).
Max. range at max. T.O. weight, including ¾ hours hold at 1,525 m. (5,000 ft.) plus 5% reserve on total fuel 2,590 km. (1,620 miles).

PERFORMANCE (15,436 kg. = 34,000 lb., Dart 528 engines).—
Cruising speed at 14,000 r.p.m. at 6,100 m. (20,000 ft.), 483 km.h. (302 m.p.h.).
Rate of climb at S/L 540 m/min. (1,770 ft./min.).
Max. rate of climb on one engine 142 m./min. 465 (ft./min.).
Service ceiling on one engine 5,185 m. (17,000 ft.).
Take-off field length on one engine (wet) 945 m. (3,100 ft.).
Take-off distance to clear 15.25 m. (50 ft.) 670 m. (2,200 ft.).
Landing field length at S/L 1,022 m. (3,350 ft.).
Max. range at T.O. weight, including ¾ hours hold at 1,525 m. (5,000 ft.) plus 5% reserve on total fuel 2,465 km. 1,540 miles).

HOLLANDAIR

HOLLANDAIR T.B.

HEAD OFFICE AND WORKS: 67A TRAMSTRAAT, KATWIJK/A/ZEE.
Managing Director: J. K. Hoekstra.
Designer: J. G. Velberg.
Works Manager: G. den Bezemer.

Hollandair was formed originally as an aeronautical trading company and began the overhaul of aircraft and engines early in 1956. In December of that year, work was started on the design of the H.A.-001 Libel agricultural aircraft, the prototype of which made its first flight in the summer of 1957.

THE HOLLANDAIR H.A.-001 LIBEL.

TYPE.—General-purpose Agricultural aircraft.

WINGS.—Braced high-wing monoplane NACA 23012 wing section. Aspect ratio 7.5. Constant chord 2.0 m. (6 ft. 7 in.). Dihedral 1° 30'. Incidence 6°. All-wood construction. Leading-edge plywood-covered: rest fabric-covered. All-wood ailerons. No flaps. Aileron area 3.5 m.² (37.67 sq. ft.). Gross wing area 30 m.² (323 sq. ft.).

FUSELAGE.—Welded steel-tube structure, fabric-covered.

TAIL UNIT.—Wood construction. Areas: fin 0.8 m.² (8.61 sq. ft.), rudder 1.0 m.² (10.76 sq. ft.), tailplane 1.80 m.² (19.38 sq. ft.), elevators 2.70 m.² (29.06 sq. ft.). Tailplane span 4.0 m. (13 ft. 1½ in.).



The Hollandair H.A.-001 Libel Agricultural Monoplane (135 h.p. Lycoming engine).

LANDING GEAR.—Non-retractable tail-wheel type. Hollandair rubber-in-compression shock-absorbers. Goodyear Aero-4 wheels, 8.50 × 6. Goodyear brakes. Wheel track 3.5 m. (11 ft. 6 in.).

POWER PLANT.—One 135 h.p. Lycoming O-290-02 four-cylinder horizontally-opposed air-cooled engine driving a Sensenich M74DM two-blade airscrew. Provision for installing as alternative one 150 h.p. Lycoming O-320 four-cylinder horizontally-opposed air-cooled engine. Fuel in two tanks in wing centre-section, adjacent to fuselage, with total capacity of 100 litres (22 Imp. gallons).

ACCOMMODATION.—Pilot's cabin is without doors to facilitate escape in an emergency.

EQUIPMENT.—Normally fitted with spray tanks under wings, with total capacity of 300 litres (66 Imp. gallons). Provision for hopper or dust container in fuselage. Can be equipped for towing sailplanes and advertising banners.

DIMENSIONS.—
Span 15 m. (49 ft. 2½ in.).
Length 8.40 m. (27 ft. 6½ in.).
Height 1.80 m. (5 ft. 11 in.).

WEIGHTS.—
Weight empty, with spray tanks 741.5 kg. (1,660 lb.).
Weight loaded 1,200 kg. (2,640 lb.).

PERFORMANCE (estimated).—
Economical cruising speed 105 km.h. (65 m.p.h.).
Spraying speed 90 km.h. (56 m.p.h.).
Stalling speed 61.5 km.h. (38 m.p.h.).
Rate of climb at S/L. 240 m./min. (790 ft./min.).
Take-off run under 100 m. (330 ft.).
Landing run under 100 m. (330 ft.).

NHI

NEDERLANDSE HELICOPTER INDUSTRIE N.V.

HEAD OFFICE AND WORKS: VLIEGVELD ZESTIENHOVEN, ROTTERDAM, W2.

Founded in October, 1955, this company is continuing the helicopter development work started by the SOBEH helicopter foundation, which was formed to design and build an experimental rotary-wing aircraft using a rotor system driven by ramjets. The prototype SOBEH H-2, now known as the NHI H-2, first flew in May, 1955 and was followed in May, 1956 by the first of the developed H-3 Kolibries.

By March, 1958, when the Kolibrie received a Certificate of Airworthiness based on the U.S. requirements for rotorcraft, it had completed 2½ years of flight testing, a 500-hour structural test and a 150-hour engine type-test.

Production of an initial series of ten Kolibries started in 1957, with NHI's two associate companies, Aviolanda and Kromhout, producing the airframes and rotor heads respectively. Kromhout also build the ramjet engines, while the rotor blades are manufactured by Fokker. Deliveries began in March, 1958, to the Dutch Central Agricultural Bureau at Rotterdam and the Directorate Wieringermeer, which is responsible for the Ijssel-Lake polders.

Four Kolibries are being sent to Netherlands New Guinea to take part in survey operations. Three others were ordered in March, 1958 by Mr. Jeremiah Renov, manager of Wings of Israel, Tel-Aviv.



The NHI H-3 Kolibrie Helicopter with Crop-spraying equipment.

THE NHI H-3 KOLIBRIE (HUMMING-BIRD).

The Kolibrie is an extremely-simple two-seat general-purpose helicopter, utilising a ramjet-powered rotor of unique design. Known as a "self-adjusting" rotor, this is somewhat analogous to an automatic variable-pitch airscrew. The blades are so designed that the centre of gravity is ahead of the centre of lift, so that air loads tend to reduce the angle of attack and neutralize disturbances. Static, dynamic, control-force and control-displacement stability have been ensured without the usual damping which reduces manoeuvrability, and no servo mechanism is needed. The aircraft is claimed to be vibration-free.

Use of a see-saw hinge adds to the simplicity of the rotor head, and the two blades are connected by a pack of leaf-springs which takes the place of conventional torsion bearings and flapping hinges. A rigid tube between the blade roots acts as a droop stop and forms a fulcrum about which the blade incidence is changed.

A further important feature of the rotor system is that the rotor has been made considerably larger and four times heavier than conventional rotors for this class of helicopter. This permits overloads of up to 300%, while the range of usable r.p.m. is increased from 10% to 50%. In conjunction with the rotor's high inertia, this results in the accumulation of about twelve times more kinetic rotor-energy for emergencies than in other helicopters.

A wide variety of accessory equipment has been produced to extend the Kolibrie's range of applications, including an under-fuselage cargo-hook with quick-release device for flying crane duties; agricultural spray-gear comprising under-fuselage tanks, pump and spray-booms; dusting and seeding equipment; pontoons and mud-skis; litters that can be carried on the landing gear each side of the cabin; and a "Helicar" trailer which can be used for road transport of the Kolibrie and as a mobile take-off and landing platform.

TYPE.—Light ramjet-powered helicopter.

ROTOR SYSTEM.—Two-bladed "see-saw" main rotor, with blades of bonded light-alloy



The NHI H-3 Kolibrie landing on its "Helicar" trailer, or mobile heliport.

construction. Pack of leaf springs attaches each blade to hub. Collective-pitch control through rigid tube under rotor. Blade chord 0.25 m. (9.8 in.). Area of each rotor blade 1.093 m.² (11.76 sq. ft.). Total main disc area 79.2 m.² (852.2 sq. ft.). Single-bladed tail rotor for directional control only, with blade of laminated wood construction.

ROTOR DRIVE.—Main rotor by ramjet engines at blade tips, anti-torque rotor by gear-box and shaft from main rotor. Main rotor r.p.m. (normal) 400. Tail rotor r.p.m. (normal) 2,700.

FUSELAGE.—Duralumin 24 ST central box-beam chassis. Short rectangular-section tail-boom carries tail rotor.

LANDING GEAR.—Metal skids with two ground-handling wheels. No shock-absorbers. Skid track 1.90 m. (6 ft. 2¾ in.). Alternatively, pontoons for amphibious operation.

POWER PLANT.—Two 60 h.p. NHI TJ-5 ramjets, burning household-grade kerosene fuel. Each weighs only 9 kg. (20 lb.) and is attached to the rotor blade tip by two bolts, the fuel-line and ignition circuits being connected automatically. One to four cylindrical tanks mounted below body on landing-gear cross struts can be used for fuel and crop-spraying liquid, as required. Maximum fuel capacity (four tanks) 440 litres (97 Imp. gallons). A 2 h.p. starting engine can be mounted on rear of rotor pylon or can be delivered as a separate item of ground equipment.

ACCOMMODATION.—Normally two seats. Alternatively, H-3 can be adapted to carry two stretchers, or crop-spraying or seed-sowing equipment, or load-carrying hook, or can be fitted with pontoons for over-water flying.

DIMENSIONS.—
Main rotor diameter, over jets, 10.06 m. (33 ft.).
Anti-torque rotor diameter 0.84 m. (2 ft. 9 in.).
Length of fuselage 4.22 m. (13 ft. 10½ in.).
Height to top of rotor pylon 2.57 m. (8 ft. 5 in.).
Width of fuselage 2.0 m. (6 ft. 6½ in.).

WEIGHTS.—
Weight empty 240 kg. (530 lb.).
Weight loaded (civil version) 650 kg. (1,434 lb.).
Weight loaded (military version) 700 kg. (1,544 lb.).
Max. rotor loading 9 kg./m.² (1.84 lb./sq. ft.).
Max. power loading 6 kg./h.p. (13 lb./h.p.).

PERFORMANCE.—
Max. speed 113 km.h. (70 m.p.h.).
Max. cruising speed 100 km.h. (60 m.p.h.).
Rate of climb at 50 km.h. (30 m.p.h.) at S/L 360 m./min. (1,200 ft./min.).
Rate of descent on one engine 600 m./min. (2,000 ft./min.).
Range (pilot only) 100 km. (60 miles).
Endurance (pilot only) 1 hour.

THE PHILIPPINE REPUBLIC

INSTITUTE OF SCIENCE AND TECHNOLOGY (FORMERLY BUREAU OF SCIENCE).

HERRAN STREET, MANILA, P.I.

Director: Dr. Joaquin Marañon.

Chief, Aircraft Research and Development Unit: Eng. Antonio J. de Leon.

The Aircraft Research and Development Unit of the Institute of Science and Technology, Manila, is conducting a programme of research and study to investigate the possibilities of aircraft construction in the Philippines. This work is being undertaken under the direction of Engineer Antonio J. de Leon.

Under this programme the Institute first designed, built and flew the XL-14 Maya and XL-15 Tagak experimental monoplanes, which were described in detail in earlier editions of this Annual. The main object in building them was to test the application of locally available materials, such as home-grown woods, plywood, bamboo, etc., to aircraft construction. One experimental material under test is "Wobex" (Woven Bamboo Experimental) which is a form of reinforced woven bamboo.

The prototype of a light two-seat touring and training monoplane, the XL-17 Musang, was completed in October, 1956 and was due to resume flight tests in 1958, after modification. A new version of the XL-15, with single tail-boom and float landing gear, is also under development as the L-21S Flying Vinta.

THE L-21S FLYING VINTA.

TYPE.—Four-seat General Utility, Liaison or Ambulance aircraft.

WINGS.—Braced high-wing monoplane. Single main bracing strut and small vertical tie-strut each side. Boeing 106 wing section. Dihedral 3°. Chord 1.56 m. (5 ft. 1½ in.). Wood structure, with single main spar and auxiliary spar. Plywood covered, with fabric covering overall. Slotted ailerons and flaps. Total area of ailerons 1.30 m.² (14.0 sq. ft.). Total area of flaps 1.66 m.² (17.87 sq. ft.). Gross wing area 17.80 m.² (191.6 sq. ft.).

FUSELAGE.—Semi-monocoque structure of all-wood construction, with plywood covering and fabric overall. Tail carried on boom of similar construction.

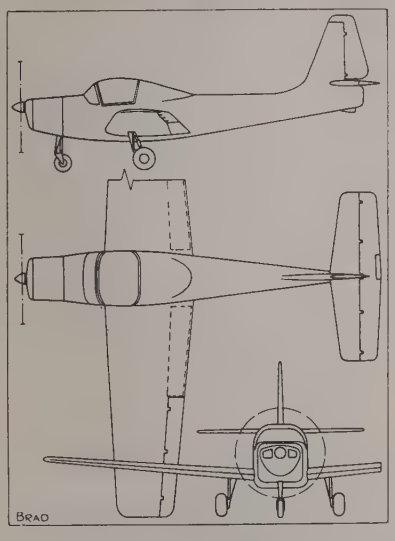
TAIL UNIT.—Cantilever monoplane type of all-wood construction. Plywood covered, with fabric overall. Statically and dynamically-balanced rudder and elevators. Trim-tab in elevators. Area of horizontal surfaces 3.47 m.² (37.35 sq. ft.). Area of vertical surfaces 1.78 m.² (19.16 sq. ft.). Span of tailplane 3.40 m. (11 ft. 2 in.).

LANDING GEAR.—Twin floats of all-wood construction, carried on streamlined tubular-steel struts. Water rudders at rear of floats. Length of floats (excluding rudders) 6.69 m. (21 ft. 11 in.). Float track 2.20 m. (7 ft. 3 in.).

POWER PLANT.—One 225 h.p. Continental O-470-B six-cylinder horizontally-opposed air-cooled engine. Two blade fixed-pitch wooden airscrew.



The XL-17 Musang (115 h.p. Lycoming O-235 engine).



The XL-17 Musang.

ACCOMMODATION.—Enclosed cabin seating four in two pairs. Door on each side. Alternatively, can accommodate pilot, one or two stretchers and attendent. Stretchers are loaded through door at rear of cabin, under tail-boom. As freighter, can carry a payload of 250 kg. (550 lb.).

DIMENSIONS.—
Span 11.40 m. (37 ft. 5 in.).
Length 8.52 m. (27 ft. 10½ in.).
Height 3.80 m. (12 ft. 6 in.).

WEIGHTS.—
Weight empty 798 kg. (1,760 lb.).
Weight loaded 1,310 kg. (2,888 lb.).
Wing loading 73.60 kg./m.² (15.07 lb./sq. ft.).
Power loading 5.82 kg./h.p. (12.83 lb./h.p.).

PERFORMANCE (estimated).—
Max. speed 217 km.h. (135 m.p.h.).
Cruising speed 196 km.h. (122 m.p.h.).
Landing speed 93 km.h. (58 m.p.h.).
Service ceiling 4,000 m. (13,120 ft.).
Range 800 km. (500 miles).
Endurance 4.35 hours.

THE XL-17 MUSANG.

TYPE.—Two-seat light Touring and Training monoplane.

WINGS.—Low-wing cantilever monoplane. Wing section U.S.-35B at root, NACA 23012 at tip. Aspect ratio 6.85. Chord 1.70 m. (5 ft. 6½ in.) at root, 1.10 m. (3 ft. 7 in.) at tip. Dihedral 5°. Incidence 2°. One-piece all wooden structure with plywood covering. Slotted ailerons. Split flaps. Total area of ailerons 1.60 m.² (17.22 sq. ft.). Total area of flaps 0.90 m.² (9.69 sq. ft.). Gross wing area 13.40 m.² (144.2 sq. ft.).

FUSELAGE.—Semi-monocoque with wooden bulkheads and stringers. Plywood covering.

TAIL UNIT.—All-wood cantilever monoplane type, with plywood covering. Areas: fin 0.74 m.² (7.97 sq. ft.), rudder 0.65 m.² (7.0 sq. ft.), elevators 1.25 m.² (13.45 sq. ft.), tailplane 1.67 m.² (17.97 sq. ft.). Tailplane span 3.40 m. (11 ft. 2 in.).

LANDING GEAR.—Fixed tricycle type. Oleo-pneumatic shock absorbers. Main wheel tyres low-pressure 8.00×4. Nose-wheel tyre 5.00×5. Hydraulic brakes. Wheel track 2.40 m. (7 ft. 10 in.).

POWER PLANT.—One Lycoming O-235-C1 four-cylinder horizontally-opposed air-cooled engine, rated at 108 h.p. and with 115 h.p. available for take-off. Two-blade fixed-pitch wooden airscrew. One 18 U.S. gallon (68 litre) fuel tank in fuselage behind seats. Oil capacity 1½ U.S. gallons (5.7 litres).

ACCOMMODATION.—Enclosed cabin with two side-by-side seats. Provision for seat or back type parachutes.

DIMENSIONS.—
Span 9.60 m. (31 ft. 6 in.).
Length 7.20 m. (23 ft. 7 in.).
Height 3.20 m. (10 ft. 6 in.).

WEIGHTS.—
Weight empty 510 kg. (1,124 lb.).
Weight loaded 735 kg. (1,620 lb.).

PERFORMANCE.—
Max. speed 203 km.h. (126 m.p.h.).
Cruising speed 161 km.h. (100 m.p.h.).
Landing speed (flaps down) 80 km.h. (50 m.p.h.).
Rate of climb at S/L. 230 m./min. (755 ft./min.).

POLAND

Following the signing of the Warsaw Treaty, the Polish aircraft industry, in common with the aircraft industries of the other signatories, was completely re-organised under Russian direction. Its factories were modernised and expanded, and various types of Russian-designed aircraft were put into production.

Simultaneously, almost all aircraft of national design were abandoned and the design offices of L.W.D. (Lotnicze Warsztaty Doswiadczalne) and C.S.S. (Centralne Studium Samolotow), which were responsible for several successful aircraft in the years immediately after the war, were dissolved. Aircraft production centres, formerly incorporated in P.Z.L. (Panstwowe Zaklady Lotnicze—State Aircraft Factories), were renamed as W.S.K. Wytwornie Sprzetu Komunikacyjnego (Transport Equipment Manufacturing Centres) to conceal the nature of their work.

The I.L. (Aircraft Institute) was allotted tasks of scientific research into specific problems of aircraft engineering. But in 1952 a small design office was established there under the leadership of T. Soltyk, former chief designer of L.W.D. This office resumed work on the nationally-designed projects, although such activities were officially discouraged and severely limited.

After the political changes of October, 1956, a second reorganisation of the Polish aircraft industry has taken place, and on October 12, 1957, an order was issued by the Minister of Heavy Industry, which brought into being the undermentioned aircraft establishment.

OSRODEK KONSTRUKCJI LOTNICZYCH (Aircraft Construction Centre).

Head Office and Works: Warsaw-Okecie.

The O.K.L. is undertaking responsibilities for design, construction, development and tests of all types of powered aircraft, aero-engines and aviation equipment, and the following six design teams are engaged there at present: Team under T. Soltyk, working on the TS-11 Iskra jet trainer; Team under F. Misztal and L. Duleba, responsible for the MD-12 four-engined feeder-line transport; Team under St. Lassota, specializing in light aeroplanes, and developing the PZL-102 two-seater, a powered glider and a six-seat multi-purpose twin-engined machine; Helicopter Team under B. Zurakowski, conducting work on the BZ-4 Zuk and JK-1 Trzmiel pulse-jet helicopter; Aero-engine Team, under W. Narkiewicz; and Aircraft Equipment Team, under St. Madeyski and G. Szelag. The O.K.L. production facilities are being greatly expanded.

The I.L. has now returned to its original task of scientific research, and is collaborating closely with the O.K.L., its activities including investigation of problems of supersonic speeds and technology of aviation materials. The second scientific institution is the I.N.B.W.L. (Scientific Research Institute of the Air Force), which is engaged on purely military work. It conducts service-suitability trials with new combat equipment.



The Polish-built Yak-12M Light General Purpose Monoplane.

Meanwhile, the production of certain types of Russian-designed aircraft continues. Single-seat jet fighters of MiG design have been in production in Poland since 1950. They were given the Polish designation LIM-1 for the initial MiG-15 version, which was first delivered to the Polish Air Force early in 1953 from the W.S.K. factory at Mielec, and LIM-2 for the improved MiG-15*bis* with more powerful engine, several hundred of which were produced before being superseded on the assembly lines by MiG-17's. According to current reports manufacture of guided weapons began in 1957.

When production of military aircraft in Poland was reduced drastically, some factories were threatened with closure or a transfer to non-aviation work. To prevent this so far as possible, licences have been obtained from Russia for construction in Poland of the Yak-12M light general purpose monoplane and the Mi-1 helicopter, which is built at the W.S.K. Pulawski Works at Swidnik under the designation SM-1. Both of these types, together with powered aircraft and gliders of Polish design, are offered for export.

The Polish aircraft industry when represented on foreign markets appears under the traditional pre-war name of P.Z.L., and some of the latest O.K.L. designs carry officially the PZL designation.

The sales of all Polish aviation products, as well as the information service, are handled exclusively by a state-controlled enterprise:—Motoimport, 26 Przemyslowa, Warsaw.

THE TS-11 ISKRA (SPARK).

Initial studies for a two-seat jet trainer, intended eventually to replace the TS-8 Bies, were prepared towards the end of 1956. The design was finalised over a year later, and the prototype is expected to fly late in 1959. The TS-11 Iskra is a mid-wing cantilever monoplane of all-metal construction, powered by a Polish-designed turbojet engine of some 600 kg. (1,300 lb.) thrust. The engine is mounted in the lower part of the fuselage, with the jet nozzle under the fuselage aft of the wings. The bifurcated air intakes are below the forward fuselage. Other design features include a cantilever T-type tail unit and a retractable tricycle landing gear.

Performance (estimated).—
Max. speed 850 km.h. (528 m.p.h.).
Service ceiling 11,000 m. (36,080 ft.).

THE MD-12.

A small four-engined feeder-liner known as the MD-12 is now in advanced stages of construction in the W.S.K. at Warsaw-Okecie. The aircraft has been developed from the twin-engined CSS-12, the original layout of which was extensively reworked in 1957 to meet the requirements of a new Polish Air Line "Lot" specification calling for a larger aircraft carrying a payload of 1,700 kg. (3,747 lb.) or 20 passengers and 200 kg. (440 lb.) of baggage.

The MD-12 is a low-wing all-metal aircraft of conventional design, powered by four 320 h.p. Narkiewicz WN-3 seven-cylinder radial engines. A larger 50-60 passenger version of advanced design, with two 1,000 h.p. Narkiewicz turboprops, is under consideration.

Dimensions.—
Span 21.3 m. (69 ft. 11 in.).
Length 15.75 m. (51 ft. 8¼ in.).
Height 5.8 m. (19 ft. 0¼ in.).
Wing area 55 m.² (592 sq. ft.).
Weight (estimated).—
Weight loaded 7,400 kg. (16,314 lb.).
Performance (estimated).—
Cruising speed at 67% power at 2,500 m. (8,200 ft.) 270 km.h. (168 m.p.h.).
Stalling speed 95 km.h. (59 m.p.h.).
Rate of climb at S/L 360 m./min. (1,180 ft./min.).
Take-off to 15 m. (50 ft.) 500-750 m. (1,640-2,460 ft.).
Normal range 460 km. (286 miles).



The PZL-102 Kos (65 h.p. Narkiewicz WN-1 engine).

THE PZL-102 KOS (BLACKBIRD).

The need for the revival of a Polish light aircraft movement—which before the war held a prominent position in the country's aeronautical activities—has now been officially recognised by the Aeroclub of Poland, but lack of suitable equipment is the main obstacle. To fill this gap the PZL-102 Kos and M-2 are being developed.

Construction of the PZL-102 began in August, 1957, at the W.S.K., Warsaw-Okecie, and the first prototype took the air for the first time on May 21, 1958. Further prototypes are being completed.

Type.—Two-seat light monoplane.
Wings.—Low-wing cantilever monoplane.

Dihedral 6°. Incidence 3°. All-metal single-spar stressed-skin structure with torsion-box leading-edge. Fabric cover on under surface aft of the spar. Wing in two sections attached to the fuselage by three fittings, two at the spar and a forward fitting. Auxiliary spar carries metal-framed fabric-covered slotted differential ailerons, and all-metal trailing-edge split-flaps inboard of ailerons. Wing area 11.02 m.² (118.6 sq. ft.).

FUSELAGE.—Rectangular section structure built in two portions, joined together by four bolts. Forward portion of welded steel-tube covered with sheet duralumin, rear portion a semi-monocoque structure built in two halves.

TAIL UNIT.—All-metal cantilever monoplane structure. Fabric-covered elevators and rudder are aerodynamically balanced. Variable-incidence tailplane. Tailplane span 2.7 m. (8 ft. 10½ in.).

LANDING GEAR.—Fixed tail-wheel type. Cantilever main units have oleo-pneumatic shock-absorbers. Low pressure tyres 400 × 150 mm. on main wheels and 200 × 80 mm. on tail-wheel. Brakes. Fully-castoring self-centering tail-wheel provided with rubber shock-absorbers. Wheel track 1.78 m. (5 ft. 10¼ in.). Wheelbase 3.8 m. (12 ft. 6 in.).

POWER PLANT.—One 65 h.p. Narkiewicz WN-1 four-cylinder horizontally-opposed air-cooled engine, driving two-blade fixed-pitch wooden M63/M30 airscrew. 60 litre (13.2 Imp. gallon) fuel tank in fuselage.

ACCOMMODATION.—Enclosed cockpit seating two side-by-side with dual controls. Large luggage compartment behind seats. Rudder pedals adjustable in flight. Cockpit heated and ventilated. Sliding canopy may be locked in three positions; closed, partly open, and fully open. Complete electric and radio equipment will be fitted to production aircraft.

DIMENSIONS.—
Span 8.49 m. (27 ft. 10½ in.).
Length 6.38 m. (20 ft. 11¼ in.).
Height 1.88 m. (6 ft. 2¼ in.).

WEIGHTS AND LOADINGS.—
Weight empty 380 kg. (838 lb.).
Weight loaded 580 kg. (1,279 lb.).
Wing loading 52 kg./m.² (10.65 lb./sq. ft.).
Power loading 9.0 kg./h.p. (19.8 lb./h.p.).

PERFORMANCE (estimated).—
Max. speed 170 km.h. (105 m.p.h.).
Cruising speed 145 km.h. (90 m.p.h.).
Stalling speed 82 km.h. (51 m.p.h.), with
Rate of climb at S/L 150 m./min. (492 ft./min.).
Ceiling 3,200 m. (10,500 ft.).
Range 500 km. (310 miles).

THE PZL-101.

The PZL-101 is a Polish-developed agricultural version of the Yak-12M, which is licence-produced in the W.S.K. at Warsaw-Okecie. The prototype successfully completed all manufacturer's trials in the Spring of 1958. Substantial orders from the Ministry of Forestry and Ministry of Agriculture are imminent.

The PZL-101 is basically similar to the Yak-12M, described fully in the U.S.S.R. section of this work, but its structure is greatly simplified and its equipment drastically reduced to the necessary minimum. Due to these changes payload is substantially increased.

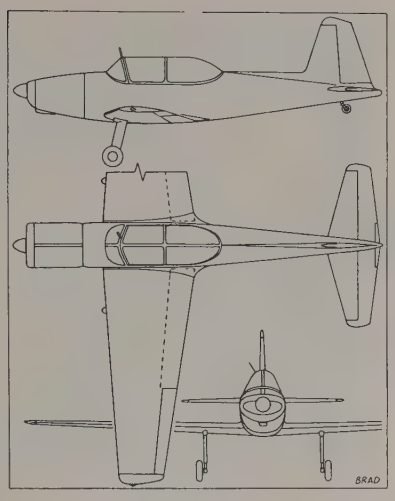
The PZL-101 is provided with large end-plates at wing tips, and carries either a hopper for 500 kg. (1,102 lb.) of dust, or tank for similar load of fluid chemicals and spray-bars. Dusting and spraying equipment is driven mechanically from the engine under control of pilot.

THE M-2.

The design team, led by Z. Szczecinski and S. Jarycha and consisting of graduates of the Warsaw Politechnic, working in the W.S.K. factory at Mielec designed a series of four aircraft under the designation of M-1, M-2, M-3 and M-4.

Several prototypes of the M-2 are now approaching completion, and the first prototype was first flown on June 26, 1958.

TYPE.—Two-seat Light Sporting and Training aircraft. Fully aerobatic at normal A.U.W.



The PZL M-2.

WINGS.—Low-wing cantilever monoplane. NACA 230 wing-section modified to give thickness/chord 15% at root and 12% at tips. Aspect ratio 6.63. Dihedral. All-metal structure. Wing in two sections, of conventional stressed skin construction, with widely spaced ribs and short supplementary single spars, attached to the fuselage at four points. Differential Frise-type ailerons of metal construction with fabric covering. Manually operated slotted flaps inboard of ailerons. Wing area 13.6 m.² (146.4 sq. ft.).

FUSELAGE.—Eliptical all-metal semi-monoque stressed-skin structure.

TAIL UNIT.—Cantilever monoplane type. All-metal structure. Fin mounted forward of tailplane. Aerodynamically balanced elevators and rudder, are fabric covered. Trim-tabs in elevators and rudder.

LANDING GEAR.—Fixed tail-wheel type. Cantilever oleo-pneumatic shock-absorber struts. Low pressure tyres diameter 400 × 150 mm. Hydraulic brakes. Self-centering tail-wheel. Wheel track 2.26 m. (7 ft. 5 in.). Wheelbase 4.83 m. (15 ft. 10¼ in.).

POWER PLANT.—One 220 h.p. Praga Doris M-208B six-cylinder horizontally-opposed air-cooled engine is fitted to prototypes. Production aircraft will have 180 h.p. Narkiewicz WN-6, or 220 h.p. Narkiewicz WN-6R six-cylinder horizontally-opposed air-cooled engine driving two blade adjustable-pitch wooden airscrew 2.3 m. (7 ft. 6½ in.) diameter. Main fuel tanks in wing roots. Additional fuel tank and installation designed for aerobatics and inverted flying in fuselage.

ACCOMMODATION.—Tandem seats under continuous sliding canopy, which is jettisonable in emergency. Complete dual controls and instrumentation. Full standard blind-flying panels. RSI-6k radio, SPU-2B intercomm. and full KP-18 oxygen equipment for production aircraft.

DIMENSIONS.—Span 9.5 m. (31 ft. 2½ in.).
Length 7.62 m. (25 ft. 0 in.).
Height 3.06 m. (10 ft. 1 in.).

WEIGHTS AND LOADINGS.—
Weight empty 735 kg. (1,620 lb.).
Weight loaded 1,020 kg. (2,248.7 lb.).
Wing loading 75 kg./m.² (15.35 lb./sq. ft.).
Power loading 4.65 kg./h.p. (10.25 lb./h.p.).

PERFORMANCE (estimated).—
Max. speed 280 km.h. (174 m.p.h.).
Cruising speed 240 km.h. (149 m.p.h.).
Landing speed 91 km.h. (56.7 m.p.h.).
Rate of climb at S/L 390 m./min. (1,280 ft./min.).
Ceiling 5,600 m. (18,372 ft.).
Range 685 km. (425 miles).

THE M-3 PLISZKA (WAGTAIL).

Designed by graduates of Warsaw Politechnic, the M-3 is a single-seat glider of all-metal construction. Work on the prototype has begun. If it is successful, the M-3 will be put into large-scale production for export and the home market.

DIMENSIONS.—
Span 14 m. (45 ft. 11½ in.).
Length 6.7 m. (22 ft. 0 in.).

WEIGHT (estimated).—
Weight loaded 285 kg. (628 lb.).

THE M-4.

At present in the design stage, the M-4 is a projected single-seat sports and aerobatic aircraft of all-metal construction, which has been developed by graduates of Warsaw Politechnic from their original M-1 design. The M-1 itself will probably not now be built.

The M-4 will be a very clean low-wing cantilever monoplane with a retractable tricycle landing gear, powered by one 160 h.p. Walter Minor 6-III six-cylinder inverted in-line air-cooled engine.

DIMENSIONS.—
Span 8.2 m. (26 ft. 11 in.).
Length 6.5 m. (21 ft. 4 in.).

PERFORMANCE (estimated).—
Max. speed 340 km.h. (211 m.p.h.).
Cruising speed 260 km.h. (161 m.p.h.).
Ceiling 5,800 km. (19,030 ft.).

THE S-4 KANIA 2 (KITE).

Intended specifically for glider-towing, the S-3 Kania was designed by Dipl.-Ing. E. Stankiewicz and the prototype was built at the S.Z.D., or Szybowcowy Zaklad Doswiadczalny (Experimental Glider Establishment) at Bielsko-Biala. It was flown for the first time on May 1, 1951, and, despite an urgent need for such an aircraft, was abandoned after only brief testing.

The latest reorganisation of the Polish aircraft industry has enabled Stankiewicz to continue development of this design, and three prototypes of a new version, designated S-4 Kania 2, were to be built in the W.S.K. factory at Mielec. Design work on Kania 2 began in April, 1956, and the first prototype was first flown on September 3, 1957.

TYPE.—Two-seat Glider-tug and General Purpose monoplane.

WINGS.—Braced parasol-wing monoplane. NACA 23012 wing section. Aspect ratio 7.34. 5° sweepback at leading-edge. Dihedral 2°. Single-spar all-wood construction with plywood D leading-edge. Fabric covering aft of spar. Wings in



The S-4 Kania 2 (125 h.p. M-11D engine).

two portions, joined together at the centre to inverted Vee pyramid structure consisting of two steel-tube side "N"s, and braced each side by a single wooden box-strut streamlined with plywood. Differential slotted ailerons are of wooden structure covered with fabric. Leading-edge slots with same span as ailerons. Wing area 20 m.² (215.3 sq. ft.).

FUSELAGE.—Plywood semi-monocoque structure with flat sides.

TAIL UNIT.—Braced monoplane type. All-wood structure. Fin and tailplane are covered with plywood, elevators and rudder with fabric.

LANDING GEAR.—Fixed tail-wheel type. Two faired side Vees and two half axles, the latter hinged to bottom of the fuselage. Rubber cord shock-absorbers. Low-pressure tyres diameter 400 × 150 mm. Brakes. Tail skid attachment point carries also towing hook and cable. Wheel track 2.2 m. (7 ft. 3 in.).

POWER PLANT.—One 125 h.p. M-11D five-cylinder air-cooled radial engine, driving two-blade wooden airscrew 2.1 m. (6 ft. 11 in.) diameter. Fuel tank with a capacity of 168 litres (36.8 Imp. gallons) in the fuselage.

ACCOMMODATION.—Two open cockpits in tandem, with dual controls, beneath cut-out in centre-section trailing edge. Large luggage compartment behind rear seat.

DIMENSIONS.—
Span 12.12 m. (39 ft. 9½ in.).
Length 8.15 m. (26 ft. 9 in.).
Height 2.35 m. (7 ft. 8½ in.).

WEIGHTS AND LOADINGS.—
Weight empty 585 kg. (1,290 lb.).
Weight loaded 903 kg. (1,990.7 lb.).
Wing loading 45 kg./m.² (9.2 lb./sq. ft.).
Power loading 7.2 kg./h.p. (15.9 lb./h.p.).

PERFORMANCE.—
Max. speed at S/L 180 km.h. (112 m.p.h.).
Cruising speed 160 km.h. (99.4 m.p.h.).
Minimum speed 55 km.h. (34.2 m.p.h.).
Rate of climb at S/L 270 m./min. (886 ft./min.).
Ceiling 5,500 m. (18,044 ft.).
Range 800 km. (497 miles).

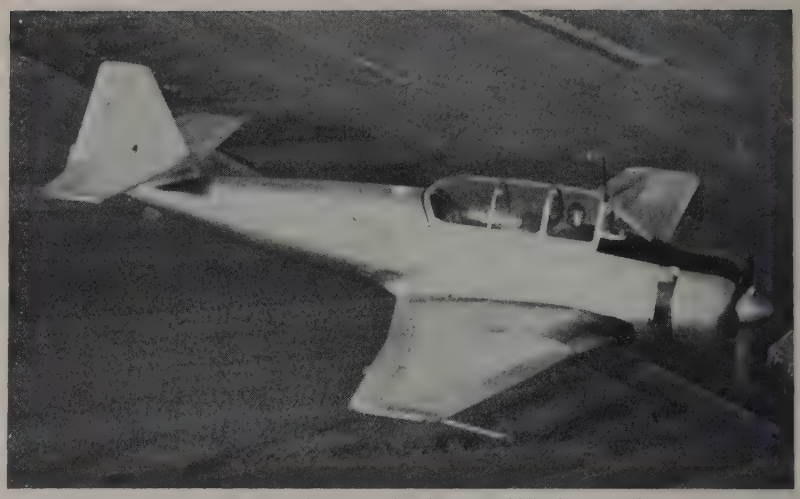
THE TS-8 BIES (FRIEND).

First aircraft of Polish design to emerge since the Soviet reorganisation of the national aircraft industry, and first to fly since the Spring of 1951, was the TS-8 Bies trainer. Designed by T. Soltyk in the design office formed at the I.L. in 1952, the first prototype flew on July 23, 1955 and the third prototype was shown in public at the Poznan Fair in July, 1956. Several more have since been completed and the Bies is in full production to replace the Junak. It is fully aerobatic and equipped for night and all-weather flying.

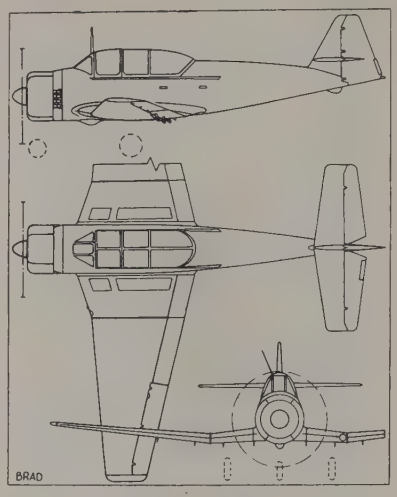
On December 28, 1956, a Bies piloted by A. Ablamowicz set up a new international height record for aircraft in the FAI class C.1c, by attaining an altitude of 7,084 m. (23,242 ft.). Later, on May 14, 1957, a Bies established a closed circuit distance record of 2,884.5 km. (1,792.3 miles) in the same class, followed on May 20, 1957 by a speed record of 320.362 km.h. (199.06 m.p.h.) over a 2,000 km. (1,243 mile) closed circuit.

TYPE.—Two-seat Basic trainer.

WINGS.—Low-wing cantilever monoplane. NACA 23012 wing section modified to give 13% t/c ratio. Aspect ratio 5.8. Incidence 0° at root, at 3° break, −1° at tip. All-metal structure. Wing in three sections, with centre-section integral with fuselage. Centre-section built around single duralumin main spar which passes through fuselage and is then swept back and down at anhedral angle inside centre-section. Nose-section torsion box formed by this spar and heavy gauge skin. Outer wings of conventional stressed-skin construction, without heavy spars. Ground-adjustable trim-tabs on ailerons. Pneumatically-operated slotted flaps. Ailerons and flaps have fabric-covered metal structure. Landing light and camera in port centre-section. Wing area 19.1 m.² (205.6 sq. ft.).



The TS-8 Bies (340 h.p. Narkiewicz WN-3 engine).



The TS-8 Bies.

FUSELAGE.—Eliptical stressed-skin metal structure.

TAIL UNIT.—Cantilever monoplane type. All-metal structure. Fin integral with fuselage. Elevators and rudder fabric-covered. Trim-tab on port elevator adjustable in flight. Ground-adjustable tab on rudder.

LANDING GEAR.—Retractable tricycle type. Pneumatic retraction. Oleo-pneumatic shock-absorbers. Main wheels fitted with low-pressure tyres size 400 × 50 mm. Pneumatic brakes. Fully-castoring, self-centring nose-wheel with hydraulic shimmy damper. Wheel track 2.35 m. (7 ft. 9 in.). Wheelbase 2.05 m. (6 ft. 9 in.).

POWER PLANT.—One Narkiewicz WN-3 seven-cylinder radial air-cooled engine rated at 320 h.p. at 2,350 r.p.m., with max. emergency power of 340 h.p. at 2,500 r.p.m. Prototypes fitted with variety of airscrews. Production aircraft have W.R.1. two-blade constant-speed metal airscrew of 2.2 m. (7 ft. 3 in.) diameter. Three fuel tanks in lower fuselage. Total fuel capacity 215 litres (47 Imp. gallons). To provide extra range under-wing fuel tanks can be fitted.

ACCOMMODATION.—Two seats in tandem under continuous transparent jettisonable canopy, with instructor to rear. Section of canopy over each cockpit can be opened rearward individually. Fully-duplicated controls and instruments. Radio operated from front seat only.

ARMAMENT (optional).—Bomb rack under each wing for total of 200 kg. (440 lb.) practice bombs.

DIMENSIONS.—
Span 10.5 m. (34 ft. 5½ in.).
Length 8.5 m. (28 ft.).
Height 3.0 m. (9 ft. 10 in.).

WEIGHTS AND LOADINGS.—
Weight empty 1,070 kg. (2,359 lb.).
Weight loaded 1,550 kg. (3,417 lb.).
Max. weight loaded (instrument trainer) 1,600 kg. (3,525 lb.).
Wing loading 81.2 kg./m.² (16.62 lb./sq. ft.).
Power loading 4.85 kg./h.p. (10.68 lb./h.p.).

PERFORMANCE.—
Max. speed 312 km.h. (194 m.p.h.).
Cruising speed 270 km.h. (168 m.p.h.).
Landing speed 90 km.h. (56 m.p.h.).
Rate of climb at S/L 408 m./min. (1,340 ft./min.).
Service ceiling 6,000 m. (19,685 ft.).
Range 800 km. (497 miles).

THE LWD JUNAK (CADET).

Designed by Dipl. Ing. T. Soltyk, who at that time, was chief designer of L.W.D., to meet the requirements of Polish flying schools, the Junak first appeared early in 1948. It was the only nationally-designed aircraft on which work was not abandoned in 1950-53 and the only post-war Polish aeroplane to be put in large-scale production until recently. The following versions have been built.

Junak 1. Prototype with Russian 125 h.p. M-11D engine. Tail-wheel type landing gear. First flew February 22, 1948.

Junak 2. Initial production version with Polish-built 160 h.p. M-11FR engine. Tail-wheel type landing-gear.

Junak 3. Similar to Junak 2, but with tricycle landing gear and comprehensive radio. Designed at the I.L. (Aircraft Institute) to meet demands for an interim transition trainer for military jet pilots until the more advanced Bies was available. Prototype flew on August 7, 1953 and two versions, Mk. 3A and Mk. 3B, have been built in quantity, differing in fuel tank installations. Still in production.

In addition, the Zuch 1 with Walter Minor 6-III six-cylinder in-line engine



The LWD Junak Mk. 3B (160 h.p. Polish-built M-11FR engine).

and Zuch 2 with a German-designed Bramo Sh-14 seven-cylinder radial engine were derived from the Junak 1, and the Zuch 2 was in limited production in 1949-50.

The Junak 1 and Zuch 1 have been described in earlier editions of "All the World's Aircraft." The following details apply specifically to the Junak 3.

TYPE.—Two-seat Basic trainer.

WINGS.—Low-wing cantilever monoplane. Wing section NACA 23012 at root, NACA 23009 at tip. In three portions. Centre-section is two-spar structure of welded chrome-molybdenum steel-tube with covering of plywood and fabric, and is integral with fuselage. Outer wings of two-spar wooden construction, with plywood covering back to rear spar and fabric covering aft of rear spar. Frise type ailerons of wooden construction. Manually-operated metal flaps. Wing area 17.5 m.² (188.4 sq. ft.).

FUSELAGE.—Welded chrome-molybdenum steel-tube structure with wooden fairings. Metal covered forward of cockpits: fabric covering aft.

TAIL UNIT.—Cantilever monoplane type. Tailplane, fin and rudder have wooden structure covered with plywood and fabric. Elevators have metal structure covered with plywood and fabric. Trim-tabs in elevators.

LANDING GEAR.—Non-retractable tricycle type. Main wheels on cantilever oleo-pneumatic shock-struts. Hydraulic brakes operated independently from each cockpit. Low-pressure tyres. Castoring nose-wheel on braced oleo-pneumatic strut with centre-lock and anti-shimmy damper. Wheel track 2.27 m. (7 ft. 5½ in.). Wheelbase 1.825 m. (6 ft.).

POWER PLANT.—One Polish-built M-11FR five-cylinder air-cooled radial engine rated at 140 h.p. at 1,760 r.p.m. and with a maximum power of 160 h.p. at 1,900 r.p.m. Enclosed in helmeted cowling and driving a Type J-6 two-blade fixed-pitch airscrew. Main fuel tank in port centre-section, between spars. Supplementary fuel tank behind fuselage firewall in Mk. 3A, in nose of port centre-section on Mk. 3B. Total fuel capacity approximately 100 litres (22 Imp. gallons).

ACCOMMODATION.—Tandem seats under transparent canopies, with pupil at rear. Dual controls and instruments, including blind-flying instruments. Canopy over forward cockpit hinges sideways and is jettisonable. Canopy over rear cockpit slides rearward. Baggage compartment behind rear seat. Radio and radio-compass.

DIMENSIONS.—
Span 10 m. (32 ft. 10 in.).
Length 7.75 m. (25 ft. 5 in.).
Height 2.5 m. (8 ft. 2¾ in.).

WEIGHTS AND LOADINGS.—
Weight empty 818 kg. (1,803 lb.).
Weight loaded 1,080 kg. (2,381 lb.).
Wing loading 62 kg./m.² (12.69 lb./sq. ft.).
Power loading 6.75 kg./h.p. (14.87 lb./h.p.).

PERFORMANCE.—
Max. speed 205 km.h. (127 m.p.h.).
Cruising speed 180 km.h. (112 m.p.h.).
Max. permissible speed 380 km.h. (236 m.p.h.).
Min. speed, flaps up, 100 km.h. (62 m.p.h.).
Rate of climb at S/L 210 m./min. (690 ft./min.).
Ceiling 4,100 m. (13,450 ft.).
Range 450 km. (280 miles).
Endurance 2½ hr.



The BZ-4 Zuk Four-seat Helicopter (320 h.p. Narkiewicz WN-4 engine).

THE BZ-4 ZUK (BEETLE).

First displayed in the Polish Aviation Day Exhibition in August, 1956, the BZ-4 Zuk four-seat helicopter completed its ground testing in 1957.

Work on the Zuk had begun at the I.L. in 1953, under the leadership of Dipl. Ing. B. Zurakowski, who had earlier designed the experimental GIL helicopter, the first successful rotating-wing aircraft built in Poland. Due to the political situation, progress was slow and the main object was to produce a simple and inexpensive prototype to develop and test the novel rotor and transmission system, which eliminates vibration and improves control.

The production model will be redesigned, cleaned up and more comfortably furnished. It is expected to be produced by the W.S.K. Pulawski Works at Swidnik, near Lublin, and four main variants are planned. These are a passenger version accommodating pilot and three passengers; an ambulance version carrying pilot, one stretcher case and attendant; an agricultural version carrying pilot and spraying or dusting equipment; and a dual control trainer.

TYPE.—Four-seat General purpose helicopter.

ROTOR SYSTEM.—Three-blade main rotor, small diameter three-blade servo-rotor above main rotor, and two-blade tail rotor. Main rotor blades of all-wood construction, except for a steel rod on leading-edge of spar to increase strength and keep the C.G. forward. Plywood covered. Main blades are rigidly mounted on hub, with no flapping hinge, but rotate about their longitudinal axis to permit cyclic pitch change. Servo-rotor consists of three metal blades of circular planform on short streamline stubs. These blades are rotated to vary their incidence, and a set of rockers joins the servo-rotor to the main rotor, acting on the main rotor blades in such a way that a change of plane of the servo-rotor head is transmitted as a cyclic pitch change for the main rotor. The servo-rotor thus decreases stick forces and stabilises the helicopter dynamically. The tail directional control and anti-torque rotor has two variable-pitch wooden blades attached rigidly to the hub. Total main disc area 113 m.² (1,216.3 sq. ft.).

ROTOR DRIVE.—Centrifugal liquid-mercury clutch integral with engine connects it with transmission shaft leading to main gearbox, which is flexibly mounted to damp out oscillations in pitch and roll transmitted to fuselage by rotor. Main and servo-rotors connected to transmission shaft by universal couplings. Tail rotor drive is taken through intermediate gearbox, with a shaft running along tail-boom to final reduction gearbox near rotor.

FUSELAGE.—Tubular steel structure with forward portion only covered with duralumin sheet. Pilot and passengers in cabin in nose; engine bay aft of cabin and fuel tanks to rear of engine. Uncovered tubular steel tail-boom carries anti-torque rotor and tail-skid.

LANDING GEAR.—Fixed four-wheel type. Front wheels, with oleo shock-absorbers, castor through 360°. Rear wheels have oleo-pneumatic shock-absorbers.

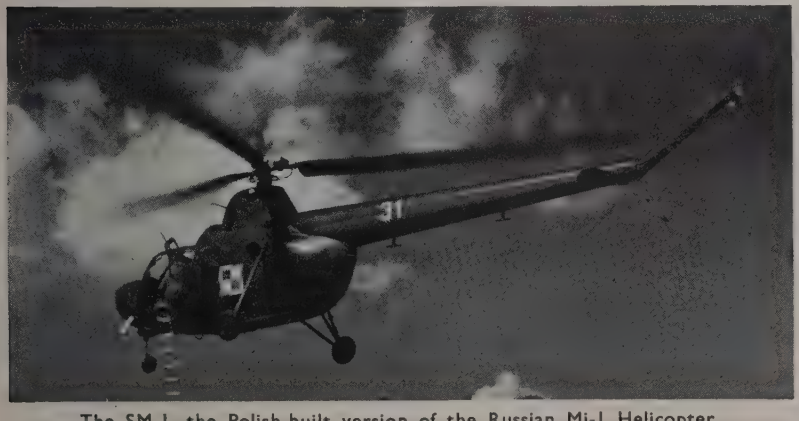
POWER PLANT.—One 320 h.p. Narkiewicz WN-4 seven-cylinder radial air-cooled engine, mounted with crankshaft vertical. Engine-driven cooling fan and air intake above cabin. Starting by compressed air injection. Two fuel tanks with total capacity of 200 litres (44 Imp. gallons) aft of engine bay. Oil capacity, 20 litres (4.4 Imp. gallons).

ACCOMMODATION.—Prototype has two side-by-side seats with dual controls and provision for seat-type parachutes. Nose panelling hinges and starboard seat folds for stretcher loading. Radio, blind-flying and night navigation equipment fitted. Conventional helicopter controls.

DIMENSIONS.—
Diameter of main rotor 12 m. (39 ft. 4½ in.).
Overall length (maximum) 12.75 m. (41 ft. 10¼ in.).
Height 2.6 m. (8 ft. 6½ in.).
Diameter of tail rotor 2.4 m. (7 ft. 10½ in.).

WEIGHTS.—
Weight empty 1,050 kg. (2,315 lb.).
Weight loaded 1,500 kg. (3,306 lb.).

PERFORMANCE (estimated).—
Max. speed 156 km.h. (97 m.p.h.).
Cruising speed 125 km.h. (78 m.p.h.).
Economical speed 80 km.h. (50 m.p.h.).
Max. vertical rate of climb 276 m./min. (905 ft./min.).
Hovering ceiling 600 m. (1,970 ft.).
Service ceiling 3,000 m. (9,840 ft.).
Range 260 km. (161 miles).
Endurance 2½ hours.



The SM-1, the Polish-built version of the Russian Mi-1 Helicopter.

THE SM-1.

SM-1 is the designation of the Polish-built version of the Russian Mi-1T general purpose helicopter, a full description of which appears in the Soviet section of this work. It is being built in the W.S.K. works at Swidnik, which in September, 1957, were named after the famous pre-war P.Z.L. designer Zygmunt Pulawski, who in the years 1928-31 evolved a series of revolutionary gull-wing fighters P-1, P-6, P-7 and P-11.

The first production SM-1 was completed in the Spring of 1956, and several versions, including liaison, ambulance and agricultural versions, are now in production. Many SM-1's are in service with the Polish Air Force, and a substantial number is being exported, mainly to Middle East countries.

On September 5, 1957, the SM-1 piloted by R. Witkowski established an international climbing speed record for rotary-wing aircraft, reaching 3,000 m. 3,000 m. (9,842 ft.) in 6 min. 46 sec. On September 11, 1957, this was improved upon by J. Gajewski, who climbed to 3,000 m. (9,842 ft.) in 6 min. 46 sec. on the same day, Gajewski also established a new International Altitude Record for rotary-wing aircraft in the F.A.I. Class E-1d by reaching a height of 6,394 m. (20,978 ft.).

THE JK-1 TRZMIEL (BUMBLE-BEE).

A new jet-powered helicopter, the JK-1 Trzmiel, designed by J. Kotlinski, a former member of Zurakowski's design team, was completed at the I.L. in the Spring of 1957 and was flight-tested later in the same year.

TYPE.—Light pulse-jet-powered helicopter.

ROTOR SYSTEM.—Two-bladed main rotor with small two-blade servo-rotor above main rotor and two-blade tail rotor. Main rotor blades, with a steel spar in the leading edge, are filled with plastic and have sheet duralumin skin. Servo-rotor of two circular planform blades mounted on short streamline stubs. Two-blade small diameter directional control rotor at the rear end of fuselage frame. Total main disc area 38 m.² (409 sq. ft.).

FUSELAGE.—Uncovered steel-tube structure.

POWER PLANT.—Two 11 kg. (24.25 lb.) s.t. Wojcicki pulse-jets mounted at tips of main rotor blades.

DIMENSIONS.—
Diameter of main rotor 7 m. (23 ft.).
Height 2.35 m. (7 ft. 8½ in.).
Weight empty 300 kg. (661 lb.).
No other data available.

THE S-2.

The S-2 is the designation given to a Polish-developed version of the SM-1 which has a redesigned forward fuselage to seat five (a pilot and four passengers). The S-2 was developed by the design team at the Pulawski Works at Swidnik, and the prototype is in advanced stages of construction.

THE IS-3 ABC-A.

The IS-3 ABC prototype was first flown in the Autumn of 1947 and entered large scale manufacture. Several variants have appeared since and the ABC-A is still in production. A substantial number was exported to China, and the glider has been built there since 1956 under a licence agreement.

The ABC-A is a single-seat strut-braced high-wing primary training glider of very simple wooden construction. It has a two-spar wing, built in two panels and fitted with ailerons which are not differentially operated. The landing gear consists of a sprung wooden skid mounted under the cockpit nacelle, with a folding wheel behind it to facilitate ground handling. An enclosed cockpit is optional.

DIMENSIONS.—
Span 9.0 m. (29 ft. 6 in.),
Length 6.0 m. (19 ft. 8 in.).
Height 1.64 m. (5 ft. 4 in.).

WEIGHT AND LOADING.—
Weight loaded 200 kg. (440 lb.).
Wing loading 13.7 kg./m.² (2.82 lb./sq. ft.).

PERFORMANCE.—
Best glide ratio at 53 km.h. (33 m.p.h.) 9.2 : 1.
Min. sinking speed at 48 km.h. (30 m.p.h.) 1.52 m./sec. (4.98 ft./sec.).
Stalling speed 45 km.h. (28 m.p.h.).
Max. winch speed 95 km.h. (59 m.p.h.).
Max. aero-tow speed 125 km.h. (77 m.p.h.).
Max. permissible free flight speed 135 km.h. (83 m.p.h.).

THE SZD-12 MUCHA 100 (FLY).

The Mucha 100 single-seat training glider is an improved version of the earlier IS-2 Mucha-ter, which set up several national records for altitude and distance. It has been exported, mainly to East Germany and China, and in 1957 China began licence production of the type.

A development known as the SZD-22 Mucha-Standard, produced for the 1958 World Championships, flew for the first time in February, 1958. Piloted by Adam Witek, it won the 15 m. class at the Championships.

The SZD-12 Mucha 100 has an all-wood structure. The cantilever wings have a single main spar and oblique auxiliary spar, and have a plywood-covered leading-edge torsion box. The ailerons are aerodynamically and mass balanced, and air brakes are fitted.

The oval-section fuselage is plywood-covered and the cockpit has a streamlined Plexiglas canopy. The landing gear consists of short front and rear skids sprung with rubber pads, and a transport monowheel.

DIMENSIONS.—
Span 15.0 m. (49 ft. 2½ in.).
Length 7.0 m. (22 ft. 11½ in.).
Height 1.65 m. (5 ft. 5 in.).

WEIGHT AND LOADING.—
Weight loaded 290 kg. (638 lb.).
Wing loading 17.3 kg./m.² (3.53 lb./sq. ft.).

PERFORMANCE.—
Best glide ratio at 70 km.h. (43.5 m.p.h.) 24 : 1.
Min. sinking speed at 60 km.h. (37.3 m.p.h.) 0.77 m./sec. (2.53 ft./sec.).
Stalling speed 50 km.h. (31 m.p.h.).
Max. winch speed 94 km.h. (58 m.p.h.).
Max. aero-tow speed 130 km.h. (81 m.p.h.).
Max. diving speed 220 km.h. (136 m.p.h.).



Some Polish Sailplanes and Gliders. *Top left*, the Bocian Z two-seat high-performance sailplane; *top right*, the Sroka single-seat sailplane; *middle left*, the Jaskolka single-seat high-performance sailplane; *middle right*, the Mucha-100 single-seat training glider; *bottom left*, the Czajka single-seat training glider and *bottom right*, the Czapla two-seat training glider.

THE SALAMANDRA 53 (SALAMANDER).

Originally produced first in 1936, the Salamandra was reconstructed in 1947 and put into quantity production. The latest model, the Salamandra 53 is still being built and in 1956 entered production in China.

The Salamandra 53 is an intermediate single-seat training glider, with a braced high-wing of all-wood construction. The single-spar wing is built in two panels and is fitted with differential ailerons and air brakes. The landing gear consists of a rubber-sprung wooden skid under the open cockpit nacelle.

DIMENSIONS.—
Span 12.50 m. (40 ft. 10 in.).
Length 6.50 m. (21 ft. 4 in.).
Height 2.30 m. (7 ft. 6 in.).

WEIGHT AND LOADING.—
Weight loaded 225 kg. (495 lb.).
Wing loading 13.30 kg./m.² (2.73 lb./sq. ft.).

PERFORMANCE.—
Best glide ratio at 49 km.h. (30.5 m.p.h.) 12.2 : 1.
Min. sinking speed at 47 km.h. (29.2 m.p.h.) 0.85 m./sec. (2.79 ft./sec.).
Stalling speed 35 km.h. (21.7 m.p.h.).
Max. winch speed 80 km.h. (50 m.p.h.).
Max. free flight speed 150 km.h. (93 m.p.h.).

THE SZD-8*bis* JASKOLKA (SWALLOW).

The SZD-8 Jaskolka appeared in 1951. Known in production form as the SZD-8*bis* Jaskolka, the first were delivered to gliding schools early in 1954. Many were exported to various countries. Several variants of the basic design have been tested in prototype form, including the 18 m. (59 ft.) span SZD-11 Albatros of 1956; the SZD-14X Jaskolka M, embodying a Rudlicki Vee-tail with variable dihedral angle; and the SZD-17X Jaskolka L, with a laminar-flow wing, Rudlicki Vee-tail, wing-tip end-plates and reserve water ballast.

Holder of several World records for speed and distance, the Jaskolka is a single-seat high-performance sailplane of wooden construction. The quickly detachable mid-set cantilever wings are of single-spar construction, plywood-covered, and fitted with aerodynamically-balanced ailerons, Fowler flaps and dive brakes. The fuselage is plywood-covered and the cockpit is enclosed by a sliding Plexiglas canopy.

A monowheel landing gear is fitted, with a mechanical brake, and there are also a short front skid and tail bumper.

DIMENSIONS.—
Span 16.00 m. (52 ft. 6 in.).
Length 7.42 m. (24 ft. 4 in.).
Height 1.41 m. (4 ft. 7½ in.).

WEIGHT AND LOADING.—
Weight loaded 340 kg. (749 lb.).
Wing loading 25 kg./m.² (5.12 lb./sq. ft.).

PERFORMANCE.—
Best glide ratio at 80 km.h. (50 m.p.h.) 26.4 : 1.
Min. sinking speed at 68 km.h. (42.3 m.p.h.) 0.76 m./sec. (2.49 ft./sec.).
Max. winch speed 110 km.h. (68 m.p.h.).
Max. aero-tow speed 150 km.h. (93 m.p.h.).
Max. diving speed 250 km.h. (155 m.p.h.).

THE SZD-8*bis* JASKOLKA Z (SWALLOW).

This is an improved production model, which carries a reserve of 100 litres (22 Imp. gallons) of water ballast to permit maximum performance in varying weather conditions.

Designed specifically for contest flying, the Jaskolka Z took part in the 1956 World Championships, and flown by Gorzelak gained third place in the single-seater class.

THE SZD-9*bis* BOCIAN (STORK).

The Bocian prototype flew in March, 1952, and production machines reached gliding centres in 1954. A substantial number was exported and licence manufacture began in China in 1957. A special competition variant, the Bocian Z, featuring wing-tip end-plates and reserve water ballast was tested in prototype form in 1956. An experimental development, adapted to take four 22 lb. Wojcicki pulsejet units mounted in pairs under the wing and known as the Bocian-Puls, was flown in 1956.



The SZD-22 Mucha Standard High-performance Sailplane built for the 1958 World Championships.

The Bocian is a high-performance two-seat sailplane with swept-forward wings, which holds several world records for speed over 200 and 300 km. closed circuits.

Of all-wood construction, the Bocian has a mid-set cantilever single-spar wing with plywood-covered leading-edge torsion box. Each aileron is in two parts, separately controlled. No flaps are fitted, but there are air-brakes inboard of the ailerons.

The fuselage is plywood-covered and the tandem seats are so arranged that the rear seat is over the C.G. and no ballast need be carried when the aircraft is flown as a single-seater. The landing gear consists of a braked monowheel and short front skid.

DIMENSIONS.—
Span 18.115 m. (59 ft. 9½ in.).
Length 7.945 m. (27 ft. 1 in.).
Height 1.98 m. (5 ft. 10 in.).

WEIGHT AND LOADING.—
Weight loaded 500 kg. (1,103 lb.).
Wing loading 25 kg./m.² (5.12 lb./sq. ft.).

PERFORMANCE.—
Best glide ratio at 80 km.h. (50 m.p.h.) 26 : 1.
Min. sinking speed at 71 km.h. (44 m.p.h.) 0.82 m./sec. (2.69 ft./sec.).
Stalling speed 52 km.h. (32.3 m.p.h.).
Max. winch speed 115 km.h. (71.4 m.p.h.).
Max. aero-tow speed 140 km.h. (87 m.p.h.).
Max. diving speed 200 km.h. (124 m.p.h.).

THE SZD-10 CZAPLA (HERON).

The SZD-10 Czapla is a two-seat glider suitable for primary training, dual control instruction, solo flying and aerobatics. It first flew in 1954 and is now in quantity production.

The Czapla is a strut-braced high-wing aircraft of all-wood construction, except for the metal bracing struts. The single-spar wings are fitted with air brakes and aerodynamically-balanced ailerons with trim-tabs. The fuselage is plywood-covered and the cockpit has a sideways-hingeing Plexiglas canopy.

The monowheel landing gear is carried between two telescopic shock-absorbers and is fitted with a brake. There are also short rubber-sprung nose and tail skids.

DIMENSIONS.—
Span 16.00 m. (52 ft. 6 in.).
Length 8.37 m. (27 ft. 6 in.).
Height 1.98 m. (5 ft. 10 in.).

WEIGHT AND LOADING.—
Weight loaded 440 kg. (968 lb.).
Wing loading 17.5 kg./m.² (3.50 lb./sq. ft.).

PERFORMANCE.—
Best glide ratio at 64 km.h. (40 m.p.h.) 17.1 : 1.
Min. sinking speed at 52 km.h. (32 m.p.h.) 0.96 m./sec. (3.15 ft./sec.).
Stalling speed 40 km.h. (25 m.p.h.).
Max. winch speed 100 km.h. (62 m.p.h.).
Max. aero-tow speed 110 km.h. (68 m.p.h.).
Max. diving speed 160 km.h. (99.4 m.p.h.).

THE SZD-15 SROKA (MAGPIE).

So far tested only in prototype form, the SZD-15 Sroka appeared early in 1956.

The Sroka single-seat intermediate glider, is a strut-braced high-wing monoplane of all-wood construction. The single-spar wings, with 4° dihedral, are provided with air brakes and slotted ailerons. The fuselage is covered with plywood and the cockpit has a sideways-hingeing Plexiglas canopy.

The landing gear is basically similar to that of the Czapla.

DIMENSIONS.—
Span 14.5 m. (47 ft. 7 in.).
Length 6.9 m. (22 ft. 8 in.).
Height 1.5 m. (4 ft. 11 in.).

WEIGHT AND LOADING.—
Weight loaded 270 kg. (595 lb.).
Wing loading 17.6 kg./m.² (3.6 lb./sq. ft.).

PERFORMANCE.—
Best glide ratio 20 min.
Sinking speed 0.84 m./sec. (2.75 ft./sec.).
Stalling speed 49 km.h. (30.5 m.p.h.).
Max. diving speed 200 km.h. (124 m.p.h.).

THE SZD-18 CZAJKA (LAPWING).

Intended as the ABC replacement, the SZD-18 Czajka was test flown in February, 1957.

A single-seat primary training glider, the Czajka, is a braced high-wing monoplane of very simple all-wood construction, except for the duralumin bracing struts. The single-spar wing is built in two panels and is fitted with differential ailerons. The landing gear consists of a sprung wooden skid under the open cockpit, and a wheel behind for easier ground handling. A cockpit nacelle is optional.

DIMENSIONS.—
Span 10.8 m. (33 ft. 1 in.).
Length 6.3 m. (20 ft. 8¼ in.).
Height 1.78 m. (5 ft. 10¼ in.).

WEIGHT AND LOADING.—
Weight loaded 201 kg. (443 lb.).
Wing loading 12.8 kg./m.² (2.6 lb./sq. ft.).

PERFORMANCE.—
Best glide ratio 12.
Min. sinking speed 1.18 m./sec. (3.87 ft./sec.).
Stalling speed 41 km.h. (25.5 m.p.h.).
Max. diving speed 133 km.h. (82.6 m.p.h.).

PORTUGAL

GOVERNMENT WORKSHOPS

OFICINAS GERAIS DE MATERIAL AERONAUTICO (GENERAL AERONAUTICAL MATERIAL WORKSHOPS).

ALVERCA DO RIBATEJO.

Director: Lieut. Colonel Engineer Fernando Alberto de Oliveira.

Assistant Director: Major Engineer Alberto Fernandes.

This factory, a department of the Portuguese Air Force, performs all repair and overhaul work for the Air Force as well as for civil aviation.

Aircraft and engines of various types have been built under licence. At present the de Havilland Chipmunk is in production.

Steel structures and ground equipment are also currently manufactured.

RUMANIA

Before the war the principal aircraft and aero-engine manufacturing organization in Rumania was the Regia Autonoma Industria Aeronautica Romana, a State establishment controlled by the Ministries of War and Marine. Apart from building aircraft of its own design under the initials I.A.R. for the Rumanian Air Force, it also manufactured Gnôme-Rhône engines under licence. It had previously built Morane-Saulnier, Potez, Fleet (U.S.A.) and PZL (Polish) aircraft under licence.

After the war the I.A.R. factory at Brasov was de-militarised by the Russian occupational authorities and later a Russo-Rumanian commercial agreement provided for the conversion of the establishment into a general engineering undertaking under joint Russian-Rumanian ownership under the name Sovromtractor. Russian interests and influence have now been withdrawn but this factory continues as a general engineering concern.

To-day, aircraft manufacture is undertaken in a factory known as U.R.M.V-3 at Brasov, and in the LFIL works at Reghin. Details of the current products of these works are given below.

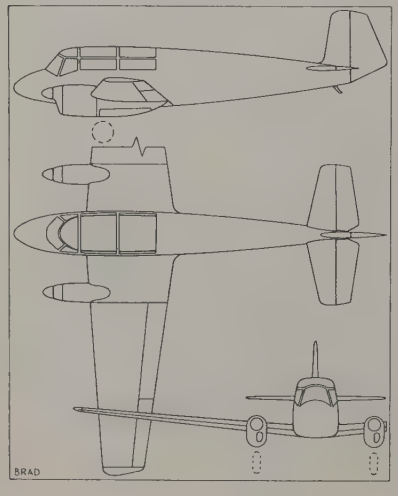
THE I.A.R. 811.

The I.A.R. 811 was the first aircraft of original design to be produced in Rumania after the war. It was a light two-seat training monoplane powered by a 60 h.p. Train engine, a French power-unit no longer in production.

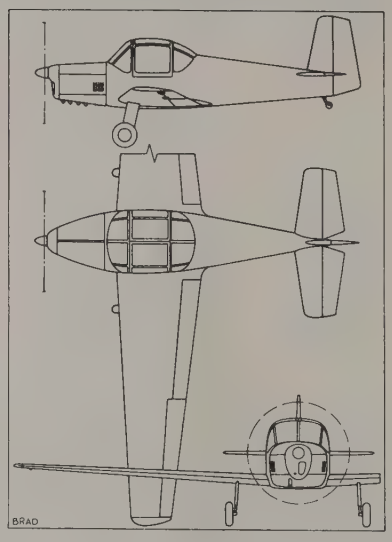
The original I.A.R. 811 flew for the first time in May, 1949, and a slightly-modified version with 65 h.p. Walter Mikron engine was later put into limited production.

THE I.A.R. 813.

The I.A.R. 813, which is in production at Brasov, is a progressive development of the I.A.R. 811.



The MR-2 (I.A.R. 814).



The I.A.R. 813.

TYPE.—Two-seat light sports and training aircraft.

WINGS.—Cantilever low-wing monoplane. Single-spar wood structure, plywood-covered. Trailing-edge flaps. Wing area 17 m.² (182.98 sq. ft.).

FUSELAGE.—Composite construction.

TAIL UNIT.—Cantilever monoplane type.

LANDING GEAR.—Non-retractable tail-wheel type. Cantilever main legs.

POWER PLANT.—One 160 h.p. Walter Minor 6-III six-cylinder in-line inverted air-cooled engine driving two-blade fixed-pitch wooden airscrew.

ACCOMMODATION.—Two seats side-by-side under transparent sliding canopy, with instructor's seat to starboard. Canopy is divided on centre-line and each half can be opened independently. Dual controls.

DIMENSIONS.—
Span 10.3 m. (33 ft. 10 in.).
Length 5.9 m. (19 ft. 4 in.).

WEIGHT.—
Weight loaded 700 kg. (1,543 lb.).

PERFORMANCE.—
Max. speed 185 km.h. (115 m.p.h.).
Landing speed 65 km.h. (40.4 m.p.h.).
Ceiling 4,200 m. (13,780 ft.).
Range 500 km. (310 miles).

THE MR-2 (I.A.R. 814).

A design study for a twin-engined air taxi, touring and ambulance aircraft known as the I.A.R. 814 was completed in 1953, and construction of two prototypes began in the following year. After these aircraft had completed their flight tests successfully, the type was put into production as a general-purpose aircraft under the designation MR-2.

The MR-2 is a low-wing cantilever monoplane powered by two 160 h.p. Walter Minor 6-III six-cylinder inverted in-line air-cooled engines and with accommodation for four passengers or two stretcher cases in addition to crew. Alternatively, up to 500 kg. (1,100 lb.) of freight can be carried when the passenger seats are removed. Blind-flying equipment and radio are fitted as standard.

The wing centre-section, carrying the engines, is built integrally with the fuselage, and flaps are fitted to the outer wings. The landing gear is retractable. Maximum fuel capacity is 340 litres (74.7 Imp. gallons) and oil capacity 36 litres (7.9 Imp. gallons).

DIMENSIONS.—
Span 14 m. (45 ft. 11 in.).
Length 11.05 m. (36 ft. 3 in.).
Height 4.2 m. (13 ft. 9 in.).

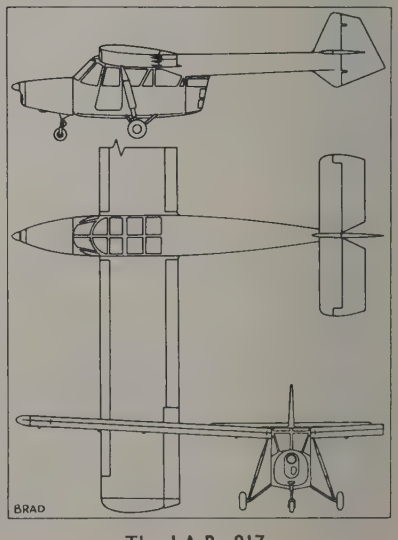
WEIGHT.—
Weight loaded 2,060 kg. (4,541 lb.).

PERFORMANCE.—
Max. speed 272 km.h. (169 m.p.h.).
Cruising speed 250 km.h. (155 m.p.h.).
Landing speed 90 km.h. (56 m.p.h.).
Climb to 3,000 m. (9,840 ft.) 22 min.
Ceiling 5,300 m. (17,385 ft.).
Range 875 km. (545 miles).

THE I.A.R. 817.

The I.A.R. 817 is a light general-purpose monoplane intended for a variety of rôles, including liaison, postal, agricultural and ambulance duties. It is powered by a 160 h.p. Walter Minor 6-III six-cylinder inverted in-line air-cooled engine and seats two persons side-by-side. The prototype was completed towards the end of 1955 and production is contemplated.

The I.A.R. 817 is a high-wing cantilever monoplane with non-retractable nose-wheel landing gear. The wings are of parallel chord and section and are equipped with leading-edge slots over almost the entire span as well as trailing-edge flaps. These features help to give the aircraft a very short landing and take-off run, even



The I.A.R. 817.

when operated from unprepared airfields. The wings can also be dismantled quickly for transport or to enable the aircraft to be towed behind a car.

The rectangular-section fuselage comprises the power plant, crew cabin with a door on each side and a cargo-space behind the seats, and a tail-boom carrying a conventional monoplane tail unit. The rear end of the cabin section is made up of two sideways-opening clamshell doors which give access to the full height and width of the cargo-space for direct loading.

No further details are available.



The RG-6 Two-seat Light Monoplane (75 h.p. Praga "D" engine).

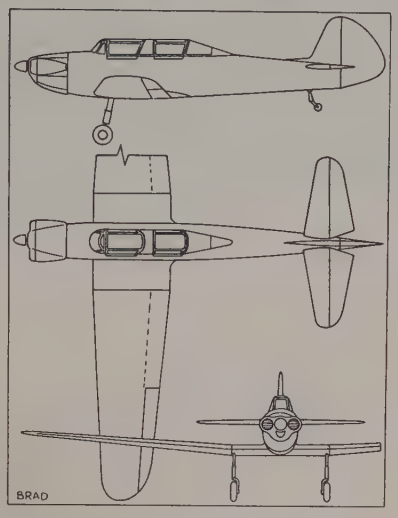
THE RG-6.

Designed by V. Novicki and built at the LFIL-Reghin factory, the RG-6 two-seat light aircraft had completed its flight testing by the beginning of 1957 and is now in quantity production for the national sports flying organisation AVSAP.

A single-seat development, the fully-aerobatic RG-6c—previously designated RG-7—powered by a 105 h.p. Walter Minor four-cylinder inverted air-cooled engine was flight-tested later in 1957.

Both the RG-6 and RG-6c took part in the National Sports Aircraft Championships in the Autumn of 1957 and achieved excellent results. The RG-6c established on this occasion several national records for aircraft of its class, including a height record of 6,700 m. (21,980 ft.) and a rate-of-climb record to 3,000 m. (9,840 ft.) in 13 min. 18 sec.

The following details apply specifically to the RG-6.



The RG-6 Two-seat Light Monoplane.

Type.—Two-seat Light Sports and Training aircraft.

Wings.—Cantilever low-wing monoplane. All-wood structure with plywood skin, built in three sections. Two-spar centre-section of constant chord and thickness integral with the fuselage. Outer panels have a single main spar and an auxiliary rear spar. Wooden-framed fabric-covered ailerons and flaps. Wing area 14.5 m.^{2} (156 sq. ft.).

Fuselage. — Elleptical - section. All - wood semi-monocoque structure.

Tail Unit.—Cantilever monoplane type. Fixed surfaces have wood frames and plywood skin. Movable surfaces are fabric-covered.

Landing Gear.—Non-retractable tail-wheel type. Main wheels on cantilever oleo-pneumatic shock-struts. Non steerable tail-wheel.

Power Plant.—One 75 h.p. Praga "D" four-cylinder horizontally-opposed air-cooled engine driving two-blade fixed-pitch wooden airscrew. Two fuel tanks with a total capacity of 70 litres (15.4 Imp. gallons) in the centre-section. Small reserve tank of 9 litres (2 Imp. gallons) capacity, behind the fuselage firewall.

Accommodation.—Tandem cockpits under a continuous transparent canopy, with a separate sideways-hingeing (to starboard) section over each seat. Complete dual controls fitted.

Dimensions.—
Span 10.5 m. (34 ft. 5½ in.).
Length 7.4 m. (24 ft. 3½ in.).
Height 2.62 m. (8 ft. 7½ in.).

Weight.—
Weight loaded 660 kg. (1,455 lb.).

Performance.—
Max. speed at S/L 180 km.h. (112 m.p.h.).
Cruising speed at 2,500 m. (8,200 ft.) 143 km.h. (88 m.p.h.).
Landing speed 55 km.h. (34 m.p.h.).
Service ceiling 3,200 m. (10,500 ft.).
Max. endurance 5 hrs.

THE SOVIET UNION

(Union of Soviet Socialist Republics)

ANTONOV

OLEG KONSTANTINOVICH ANTONOV.

Best-known a few years ago for his successful glider and sailplane designs, Antonov has now established himself as one of Russia's leading designers of transport aircraft, particularly those types intended for short-field operation.

Details of the current products of his design bureau are given hereafter.



The An-2S Agricultural Biplane (1,000 h.p. ASh-62 IR engine).

THE AN-2.

NATO Code Name: "Colt."

The An-2, which was built to a specification of the Ministry of Agriculture and Forestry of the U.S.S.R. as a replacement for the Il-12, Li-2 and Po-2 Series, first flew in 1947 under the designation SKh-1 (Selskokhozyaistvennyi-1 = agricultural-economic-1). It was later officially designated An-2.

The An-2 is capable of operating out of small airfields and has now taken over most of the duties of the old Po-2 biplane, such as rescue and ambulance work, passenger and cargo transport, photographic and geophysical survey, forestry patrol and agricultural work, parachute training, etc.

Well over 2,000 An-2's have been built for service with the Soviet armed forces, Aeroflot and other civilian organisations. The type has been exported to a number of Socialist States, including East Germany and Bulgaria. It is also being built in China, where the first locally-produced An-2 was completed in December, 1957.

Early An-2's had an ASh-21 engine, but the current production models have an ASh-62IR engine. The following versions exist.

An-2P. Standard general-purpose aircraft. Used by Aeroflot to carry 8-12 passengers or equivalent freight.

An-2S. Agricultural biplane differing, mainly in having a long-stroke landing gear. This permits the installation of pumping and spraying equipment under the fuselage and wings.

An-2V (design bureau number An-6). Floatplane version of An-2. In series production following tests in 1954-55. Floats are approximately 7.5 m. (24 ft. 7 in.) long and, as they have a very shallow draught, the An-2V can be used in water 0.8-1.2 m. (2 ft. 7½ in. to 3 ft. 11 in.) deep. Curved-blade airscrew of An-2 replaced by one with straight, blunt-ended blades.

An-2SA (design bureau number An-4). For high-altitude meteorological research. Has an extra cockpit immediately forward of the fin, from which ice accretion and other weather phenomena may be watched. Powered by an ASh-62 IR/TK engine, with a turbo-compressor mounted externally on the starboard side to maintain 850 h.p. up to a height of 9,500 m. (31,000 ft.). Other modifications include deletion of the airscrew spinner and a longer carburettor air intake. Unslotted ailerons are installed on this version, which is fitted with a glider-towing hook.

An An-2SA established an FAI-recognised height record for its class of 11,248 m. (36,880 ft.), on July 19, 1954, as well as an earlier record in the previous year.

The following data apply specifically to the Standard An-2P.

TYPE.—Single-engined General Purposes biplane.

WINGS.—Unequal-span single-bay biplane. Metal structure, fabric-covered. I-type interplane struts. Approximately 2.8° dihedral on both wings. Slotted flaps on all four wings, slotted ailerons and auto-slots on upper wings only.

FUSELAGE.—All-metal stressed-skin structure of circular section forward of cabin, rectangular in the cabin section and oval in the tail section.

TAIL UNIT.—Braced monoplane type. Fin integral with rear fuselage.

LANDING GEAR.—Fixed split-axle type with long-stroke oleo shock-absorbers. Pneumatic brakes. Wheels interchangeable with floats or skis.

POWER PLANT.—One 1,000 h.p. ASh-62 IR nine-cylinder radial air-cooled engine. Four-blade airscrew. Fuel tanks in upper wings. Total capacity 1,280 litres (280 Imp. gallons).

ACCOMMODATION.—Flight compartment forward of upper wing seats two side-by-side with dual controls. Cabin provides accommodation for up to 12 passengers or 14 paratroops or 1,500 kg. (3,306 lb.) of freight or six stretchers. Large door on port side.

EQUIPMENT.—Wide range of equipment may be installed for various duties. For photographic survey and other work two fixed semi-automatic AFA-33/50 or one AFA-33/75 and one AFA 18/21 cameras are used; for agricultural work M-600 pump, fluid containers of 1,000 litres (220 gal.) capacity or hopper with capacity of 1,135 kg. (2,500 lb.) etc. are provided; for geological survey a Geiger-Müller apparatus, magnetometer, etc. are fitted.

DIMENSIONS.—
Span 16.46 m. (54 ft. 2¼ in.).
Length 10.42 m. (34 ft. 3 in.).
Height 4.7 m. (15 ft. 5 in.).

WEIGHTS.—
Weight empty 2,720 kg. (5,985 lb.).
Payload 1,500 kg. (3,300 lb.).
Max. loaded weight 5,000 kg. (11,000 lb.).

PERFORMANCE.—
Max. speed at S/L. 250 km.h. (155 m.p.h.).
Speed at 2,000 m. (6,560 ft.) 220 km.h. (137 m.p.h.).
Cruising speed 180 km.h. (112 m.p.h.).
Minimum speed 64 km.h. (40 m.p.h.).
Climb to 4,000 m. (13,120 ft.) 40 min.
Service ceiling 8,230 m. (27,000 ft.).
Landing run 150 m. (490 ft.).
Max. range 1,200 km. (745 miles).

THE ANTONOV NRK.

The NRK, a prototype of which was being evaluated for military purposes in 1956, is a variant of the An-2 produced as a slow-flying artillery-control and reconnaissance aeroplane.

It has twin fins and rudders to permit installation of a tail turret with a single 23 mm. cannon. Otherwise it is thought to be identical to the standard An-2.

THE AN-4 and AN-8.

NATO Code Name: "Camp."

The design of this twin-engined transport aeroplane was originated in 1952-1953, and the prototype was first exhibited publicly at Tushino in 1956.

The aircraft is adaptable to both civil and military duties under the following designations:—

An-4. Military assault transport for the Soviet Air Force.

An-8. Civil freighter version for Aeroflot, presumably with tail gun-turret deleted.

TYPE.—Twin-engined Passenger and Freight-carrying monoplane.

WINGS.—High aspect ratio cantilever type, with slight dihedral from roots.

FUSELAGE.—All-metal structure sharply swept up towards tail to permit entry of bulky loads through rear ventral doors.

TAIL UNIT.—Cantilever tailplane; fin and rudder with dorsal extension.

LANDING GEAR.—Retractable tricycle type. Two main wheels in tandem in each fuselage-side fairing.

POWER PLANT.—Two 5,100 h.p. Kuznetsov turboprop engines.

ACCOMMODATION.—Pilots sit above navigator, whose compartment is in the glazed nose of the fuselage. The prototype has a manned tail gun position under the rudder. The main cabin can accommodate about 40 troops.

EQUIPMENT.—Navigational radar in blister under nose; full radio.



The An-2SA High-Altitude Meteorological Research Biplane.



The An-4 Military Assault Transport (two 5,100 s.h.p. Kuznetsov turboprop engines).

ARMAMENT (An-4).—Single cannon in tail gun-turret.
DIMENSIONS (approx.).—
Span 30 m. (98 ft. 5 in.).
Length 26 m. (85 ft. 4 in.).
WEIGHTS.—
Normal weight loaded 35,000 kg. (77,160 lb.).
Max. weight loaded 40,000 kg. (88,185 lb.).
PERFORMANCE (estimated).—
Max. speed 610 km.h. (380 m.p.h.).
Cruising speed 480 km.h. (300 m.p.h.).
Range 2,815 km. (1,750 miles).

THE AN-10 and AN-16 UKRAINA (UKRAINE).

NATO Code Name: "Cat."

Design of the An-10 passenger transport aeroplane began in November, 1955 and it first flew in March, 1957. In general its layout is on the same lines as that of the earlier twin-turboprop An-8, and it has obviously been designed for domestic operation by Aeroflot from large or small airfields.

The two prototypes have Kuznetsov NK-4 turboprops, but production aircraft are available with engines incorporating improvements by A. G. Ivchenko and designated AI-20. Antonov has claimed that the latter engine makes the Ukraina "perhaps the most economical of all the world's transport aircraft."

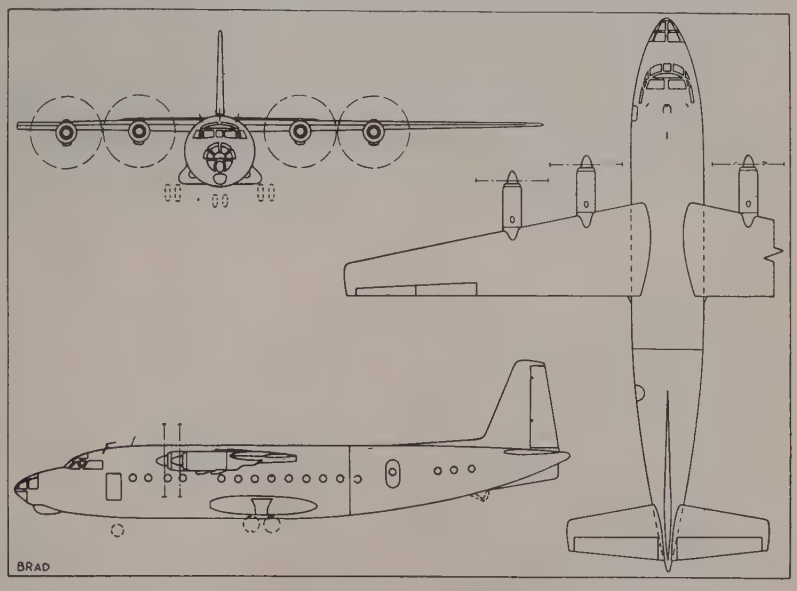
Versions of the Ukraina so far announced are as follows :—

An-10. Initial version. One of the prototypes, displayed at Vnukovo Airport Moscow, in July, 1957, had seats for 84 passengers in three cabins, with a "playroom" for children at the rear. With six-abreast seating and no galley, up to 126 passengers could be accommodated.

An-10A. Developed version with fuselage lengthened by 2.0 m. (6 ft. 7 in.). Details below refer to this type. At least ten built by April, 1958.

An-16. Projected further development of An-10, with fuselage length increased to 40 m. (131 ft. 3 in.) to accommodate 130 passengers. Modifications increase height of under-floor cargo hold to 1.20 m. (4 ft.).

TYPE.—Four-engine passenger Transport.
WINGS.—Cantilever high-wing monoplane. All-metal construction. Sweep-back on



The An-10 Ukraina Airliner.



The An-10 Ukraina Airliner (four 4,000 h.p. Kuznetsov NK-4 turboprop engines).



The An-10 Ukraina Airliner (four 4,000 h.p. Kuznetsov NK-4 turboprop engines).

leading edge from roots. Double slotted flaps. Thermal de-icing. Wing area 120 m.² (1,292 sq. ft.).

Fuselage.—Circular stressed-skin monocoque structure. Loading ramp for freight under rear fuselage.

Tail Unit.—Cantilever monoplane type. Small stabilising fin under rear fuselage.

Landing Gear.—Retractable tricycle type. Hydraulic actuation. Four-wheel bogie on each side retracts into blister at fuselage side; dual nose-wheels. Main wheel tyre pressure 5.6-6.7 kg./cm.² (80-95 lb./sq. in.).

Power Plant.—Four 4,000 h.p. Kuznetsov NK-4 or Ivchenko AI-20 turboprops driving four-blade reversible-pitch airscrews, diameter 4.50 m. (14 ft. 9 in.). All fuel in wings.

Accommodation (An-10A).—Crew of five. Pilot and co-pilot side-by-side, with third seat for radio-operator behind in deep well. Navigator in glazed nose compartment. Seats for 100 passengers. Volume of cabin 222 m.³ (7,840 cub. ft.). Cabin headroom 2.75 m. (9 ft.). Pressurised to differential of 0.56 kg./cm.² (8.0 lb./sq. in.), giving equivalent of sea level at 5,200 m. (17,000 ft.). Volume of cargo hold 42 m.³ (1,483 cub. ft.).

Dimensions (An-10A).—
Span 38 m. (124 ft. 7 in.).
Length 37 m. (121 ft. 5 in.).
Height 9.8 m. (32 ft. 1 in.).

Weights (An-10A).—
Max. payload 14,333 kg. (31,600 lb.).
Max. loaded weight (full payload and 12,820 litres = 2,820 Imp. gallons of fuel) 55,110 kg. (121,500 lb.).
Wing loading 430 kg./m.² (88.0 lb./sq. ft.).

Performance (An-10A).—
Max. speed at 8,000 m. (26,250 ft.) 777 km.h. (483 m.p.h.).
Cruising speed 600-650 km.h. (373-404 m.p.h.).
Rate of climb at S/L 600 m./min. (1,970 ft./min.).
Rate of climb at S/L on three engines 390 m./min. (1,280 ft./min.).
Rate of climb at S/L on two engines 145 m./min. (475 ft./min.).
Max. take-off run 700 m. (2,300 ft.).
Max. landing run 700 m. (2,300 ft.).
Landing run with reverse pitch propellers approx. 500 m. (1,600 ft.).
Range at 9,750 m. (32,000 ft.) with max. payload and 1 hr. reserves 2,000 km. (1,240 miles).
Range with 10,430 kg. (23,000 lb.) payload 3,100 km. (1,925 miles).
Range with 8,435 kg. (18,600 lb.) payload 3,425 km. (2,128 miles).

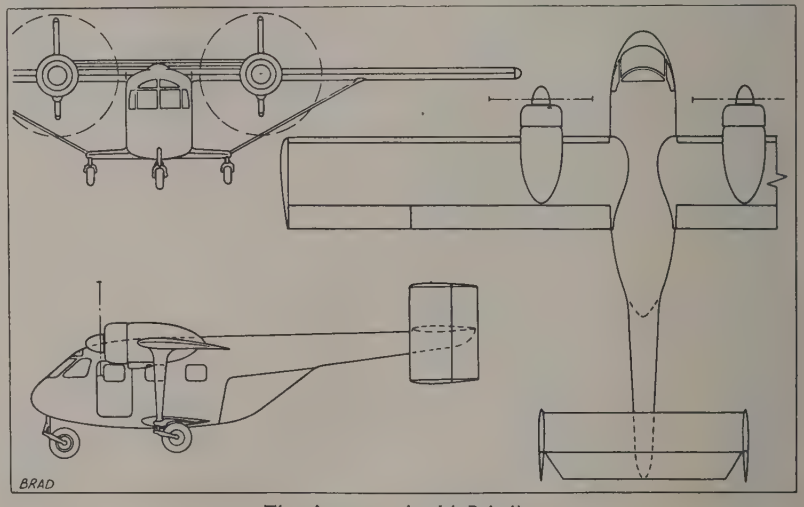
THE AN-14 PCHELKA (LITTLE BEE).

The An-14 Pchelka (Little Bee) is a light general purpose aircraft, the first prototype of which made its first flight on March 15, 1958. It is a braced high-wing monoplane, powered by two 260 h.p. Ivchenko AI-14R radial engines and fitted with a tricycle undercarriage. The very large twin fins and rudders are carried on a tail-boom to permit easy loading of the cabin through large rear loading doors. Accommodation is provided for six passengers and 150 kg. (330 lb.) of luggage, or 600 kg. (1,320 lb.) of freight.

Its designer has stated that his aim was to produce an aeroplane that would equal the helicopter in take-off and landing performance, but be superior in every other respect. It was to be simple enough for a lorry driver to pilot after a brief course of instruction, and was required for rapid communications, delivery of mail, and various medical and agricultural duties in undeveloped areas. It is reported to have a maximum speed of 233 km.h. (145 m.p.h.) a cruising speed of up to 212 km.h. (132 m.p.h.) and stalling speed of 50 km.h. (31 m.p.h.). It has a normal range of 530 km. (330 miles) and lands in 50-60 m. (165-200 ft.).

THE A-13.

Latest glider designed by Antonov is the all-metal single-seat A-13, of which a few details were released early in 1958. It is a cantilever mid-wing monoplane with a V-tail and is described as having two sets of interchangeable wings, one set for aerobatics and the other for practice and long-distance flying.



The Antonov An-14 Pchelka.



The An-14 Pchelka Light General Purpose Monoplane.

BERIEV

G. M. BERIEV.

Beriev is one of a number of Soviet designers about whose work relatively little is known. He may have studied under Grigorovich, and has been working on seaplanes since the late 1920's or early 1930's.

The Be-6 has been in standard service with Aeroflot and the Military Aviation Forces of the Soviet Navy since approximately 1949-50; what is thought to have been the prototype or an early production model appeared at Tushino in 1951 (see this Annual, 1952-53 edition).

THE BE-8.

The Be-8 was designed as a successor to the Be-6, powered by two VK-1 turbojet engines. It is of much cleaner design and has a considerably higher performance; but although the prototype flew in 1951 there have been no reports of any subsequent production.

THE BE-6.

NATO Code Name: "Madge."

TYPE.—Twin-engined Reconnaissance and Transport Flying-boat.

WINGS.—Gull-type wing of high aspect ratio, tapered from roots.

FUSELAGE.—Flying boat hull, with two steps.

TAIL UNIT.—Dihedral tailplane with end-plate twin fins and rudders.

LANDING GEAR.—Hull; floats near wing-tips.

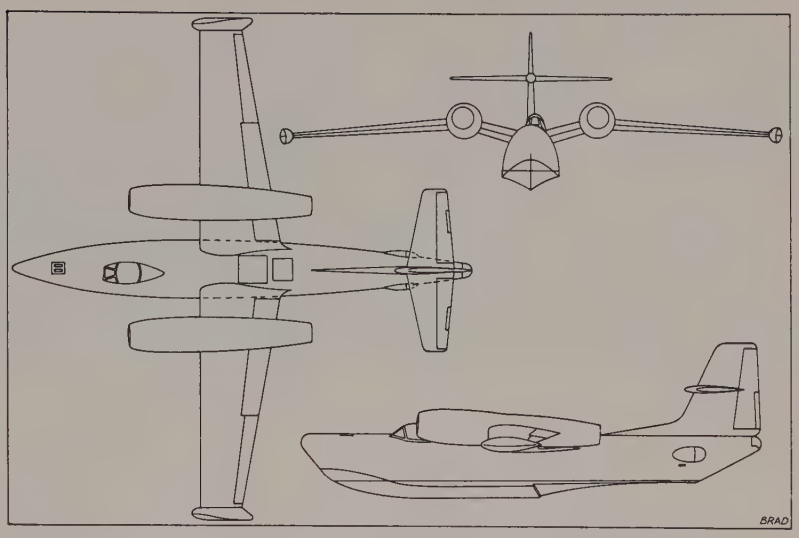
POWER PLANT.—Two 2,000 h.p. ASh-73 radial engines.

ACCOMMODATION.—Crew of eight.

ARMAMENT.—Nose, dorsal and remotely-controlled tail gun-turrets containing 23 mm. cannon. Racks for bombs, mines, depth charges, torpedoes, etc., under wings, outboard of engines.

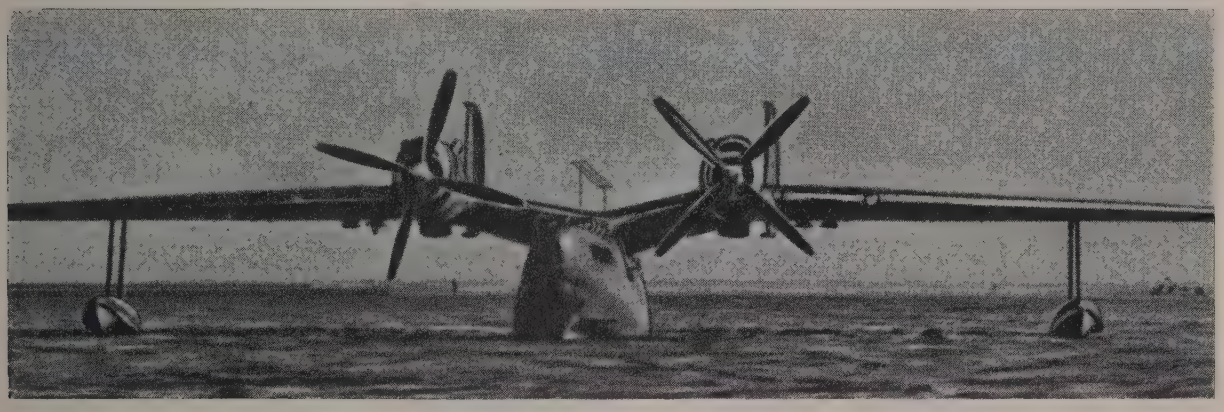
DIMENSIONS.—
Span 33 m. (108 ft. 3¼ in.).
Length approx. 25.6 m. (84 ft.).

WEIGHT.—
Loaded weight 23,400 kg. (51,588 lb.).



The Be-8 Twin-jet Reconnaissance Flying-boat (provisional drawing).

PERFORMANCE.—
Max. speed at 2,400 m. (7,875 ft.) 415 km.h. (258 m.p.h.).
Min. speed 155 km.h. (96 m.p.h.).
Range 4,900 km. (3,045 miles).



The Beriev Be-6 Reconnaissance Flying-boat (two 2,000 h.p. ASh-73 engines).

ILYUSHIN

SERGEI VLADIMIROVICH ILYUSHIN.

Ilyushin is an active designer of diverse aircraft types. In March, 1952, in collaboration with ten co-workers, he was awarded a Stalin Prize of 150,000 roubles for "new work in aircraft construction."

Aircraft designed by Ilyushin and currently in service include the Il-28 twin-jet bomber and the Il-12 and Il-14 light transport aircraft. In addition, the four-turboprop Il-18 transport is in quantity production for service with Aeroflot.

THE IL-28.

NATO Code Name: "Beagle."

The Il-28 first appeared in numbers over Moscow on May Day, 1950, and has been the standard twin-jet tactical bomber of the Soviet air forces for many years. Large numbers have been delivered to Poland, Rumania, China and Indonesia. In addition, the Il-28 has been manufactured in Czechoslovakia for the air forces of that country and of Egypt.

TYPE.—Twin-jet Light Attack Bomber.

WINGS.—Shoulder-wing cantilever monoplane with straight leading-edge and swept-forward trailing-edge.

FUSELAGE.—Circular-section all-metal structure.

TAIL UNIT.—Swept-back surfaces, tailplane dihedral.

LANDING GEAR.—Main wheels retract forward and lie flat in nacelles. Double nose-wheel.

POWER PLANT.—Two VK-1 centrifugal-flow turbojet engines (each 2,700 kg. = 5,955 lbs. s.t.). Fuel capacity 11,900 litres (2,620 gallons) with provision for additional fuel in wing-tip tanks.

ACCOMMODATION.—Crew of four. Tail gunner's position under rudder, with power-operated entry hatch in bottom of fuselage.

ARMAMENT AND EQUIPMENT.—Two fixed forward-firing automatic aircraft guns in lower part of nose, thought to be 20 mm.



The Ilyushin Il-28 Light Attack Bomber (two VK-1 turbojet engines).

NS type. Two 23 mm. guns in tail turret. Bomb loads believed to total up to maximum 3,000 kg. (6,600 lb.). Bombsight is thought to be German-designed synchronus optical type with a ceiling of 15,000 m. (49,200 ft.). Radar equipment for navigation and blind bombing in scanner radome below forward fuselage. Radio equipment probably includes an RS1-6 transmitter-receiver and an RSB-*bis* for transmission and reception on broader frequency ranges. In later versions VHF equipment may replace the RS1-6. An IFF set and radio compass or RDF are provided.

DIMENSIONS (approx.).—
Span 20.75 m. (68 ft.).
Length 18.9 m. (62 ft.).

WEIGHTS (estimated).—
Weight empty 11,795 kg. (26,000 lb.).
Normal loaded weight 17,235 kg. (38,000 lb.).
Max. loaded weight 19,960 kg. (44,000 lb.).

PERFORMANCE (estimated).—
Max. speed 935 km.h. (580 m.p.h.) up to 6,000 m. (19,680 ft.).
Cruising speed 725 km.h. (450 m.p.h.) at 10,000-12,000 m. (32,800-39,360 ft.).
Rate of climb 900 m./min. (2,950 ft./min.) at 3,000 m. (9,840 ft.).
Range (with max. bomb load) 2,400-2,500 km. (1,490-1,550 miles).

THE IL-28U TRAINER.
NATO Code Name: "Mascot."

In 1951 there appeared a trainer version of the Il-28 bomber. This differs from the operational version in having a stepped-down tandem cockpit arrangement and lacks the radome. Generally it does not carry all the armament of the standard bomber version.

The Il-28U is in service with the Soviet Air Fleet and also in Czechoslovakia and Rumania.

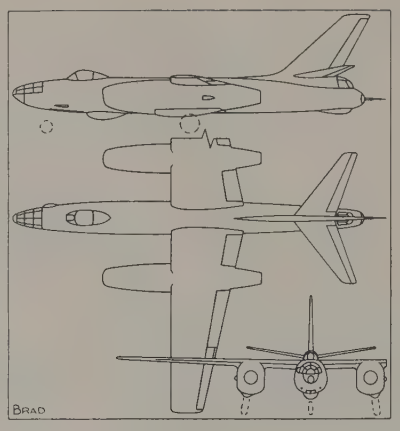
The general performance of this version is thought to be similar to that of the Il-28, although the range is likely to be greater.

THE Il-18 MOSKVA (MOSCOW).
NATO Code Name: "Coot."

Although the Il-18 is of much the same size as the contemporary Antonov An-10, it is of more sophisticated design and will be used by Aeroflot on international services as well as on domestic routes. The prototype flew for the first time in mid-1957 and had made three flights at the time of its first public appearance at Vnukovo Airport, Moscow, in July of that year. The type is now in production, with first deliveries expected during the Summer of 1958.

Like the An-10, the Il-18 was powered initially by Kuznetsov NK-4 turboprops and is offered with either these engines or the improved Ivchenko AI-20 version. In common with all modern Soviet civil aircraft except the Tu-114, it has manual aerodynamically-balanced flying controls.

Standard cabin layouts are for 75 or 98 passengers, with individual reading lights, call-buttons, ventilators and tables at each seat row. V.I.P. transport and freighter versions are believed to be under development.



The Ilyushin Il-28.

TYPE.—Four-engine Passenger transport.

WINGS.—Cantilever low-wing monoplane. Aspect ratio 10. Mean thickness/chord ratio 14%. All-metal structure. Three spars in centre-section ; two in outer wings. All-metal ailerons are mass-balanced and aerodynamically-compensated, and fitted with spring-tabs. Wing area 140.0 m.² (1,507 sq. ft.).

FUSELAGE.—All-metal monocoque structure.

TAIL UNIT.—Cantilever monoplane type. Trim-tabs on rudder and elevators. Additional spring-tab on rudder.

LANDING GEAR.—Retractable tricycle type. Hydraulic actuation. Four-wheel bogie main units, with 900 mm. × 285 mm. tyres and hydraulic brakes. Steerable (45° each way) twin nose-wheel unit, with 700 mm. × 250 mm. tyres. Tyre pressure 6.5 kg./cm.² (92.4 lb./sq. in.). All units retract forward for slipstream-assisted free fall in an emergency.

POWER PLANT.—Four 4,000 h.p. Kuznetsov NK-4 turboprops, or four 4,000 h.p. Ivchenko AI-20 turboprops, driving type AB-68B four-blade reverse-pitch airscrews, diameter 4.2 m. (13 ft. 9 in.). All fuel in flexible bag tanks in centre-section, with total capacity of 24,000 litres (5,280 Imp. gallons). Alternatively, integral tanks may be provided in centre-section with total capacity of 27,000 litres (5,940 Imp. gallons).

ACCOMMODATION.—Crew of five, comprising two pilots, navigator, wireless operator and flight engineer. Alternative accommodation for either 75 or 98 passengers. In 75-seat version, there is a forward cabin for 10 persons and a rear cabin for 65 persons, all in five-abreast rows, with a headroom of 2 m. (6 ft. 6 in.). Between the cabins, in line with the airscrews, is a galley. Aft of the rear cabin is the main passenger entrance door on the port side, with a wardrobe opposite and two toilets to the rear. A compartment for luggage, forward of the front cabin, has a volume of 7 m.³ (247 cub. ft.). Pressurised cargo holds forward and aft of the wing each have a volume of 14 m.³ (495 cub. ft.). A further, unpressurised, hold aft of the rear pressure bulkhead has a volume of 17 m.³ (600 cub. ft.). Cargo access doors measure 1.2 m. × 0.9 m. (3 ft. 11 in. × 2 ft. 11 in.). Cabin has volume of 250 m.³ (8,830 cub. ft.) and is pressurised to a maximum differential of 0.5 kg./cm.² (7.1 lb./sq. in.), giving equivalent of 2,375 m. (7,800 ft.) at cruising altitude of 9,750 m. (32,000 ft.).

DIMENSIONS.—
Span 37.4 m. (122 ft. 8½ in.).
Length 35.66 m. (117 ft. 0 in.).
Height 10.15 m. (33 ft. 5 in.).

WEIGHTS (98-passenger version).—
Weight empty 28,000 kg. (61,730 lb.).
Max. payload 14,000 kg. (30,865 lb.).
Weight loaded (with 14,600 litres = 3,210 Imp. gallons fuel) 53,975 kg. (119,000 lb.).

WEIGHTS (75-passenger version).—
Weight empty 28,000 kg. (61,730 lb.).
Max. payload 12,000 kg. (26,455 lb.).
Weight loaded (with 24,000 litres = 5,280 Imp. gallons fuel) 58,000 kg. (127,870 lb.).
Wing loading 415 kg./m.² (85 lb./sq. ft.).

PERFORMANCE.—
Max. cruising speed at 8,000 m. (26,250 ft.) 650 km.h. (404 m.p.h.).
Landing speed 160 km.h. (100 m.p.h.).
Take-off distance 750-900 m. (2,460-2,950 ft.).
Landing distance 500-600 m. (1,640-1,970 ft.).
Range with max. payload and 1 hr. reserves 3,000 km. (1,865 miles).
Range with max. fuel and 1½ hr. reserves in still air 5,000 km. (3,100 miles).

THE IL-14.
NATO Code Name: "Crate."

The Il-14 differs externally from the Il-12 mainly in having a revised tail configuration, blunter wing-tips and some thrust augmentation similar to that employed in the Convair-Liner.

There are two main versions, as follows :—

Il-14P. Standard civilian version accommodating 18 passengers in three-abreast rows or 26 passengers in four-abreast rows, with two single seats. Also in production at the Georgi Dimitrov works at Letnany, Prague, Czechoslovakia, where it is known as the Avia-14, and in East Germany.

Il-14M. Developed version with lengthened fuselage, capable of accommodating 24 or 28 passengers.

The Polish airline LOT has some Il-14's and some military examples were supplied to the Egyptian Air Force early in 1956.

TYPE.—Twin-engined Transport.

CONSTRUCTION.—Similar to Il-12

POWER PLANT.—Two ASh-82T fourteen-cylinder radial air-cooled engines, each rated at 1,900 h.p. at 2,600 r.p.m. for take-off and driving four-blade AV-50 metal airscrews of 3.80 m. (12 ft. 6 in.) diameter. Fuel capacity 2,500 litres (550 Imp. gallons).

ACCOMMODATION (Il-14P).—Crew of five. Standard seating for 18 passengers. Alternative accommodation for 26 passengers. Rear starboard passenger door. Toilet at rear ; luggage space and galley aft of flight deck.

ACCOMMODATION (Il-14M).—Standard seating for 24-28 passengers, with toilet, galley and luggage hold.

DIMENSIONS (Il-14P).—
Span 31.70 m. (104 ft.).
Length 21.31 m. (69 ft. 11 in.).
Height 7.95 m. (26 ft. 1 in.).



The Il-18 Moskva Airliner (four 4,000 h.p. Kuznetsov NK-4 turboprop engines).



The Ilyushin Il-14 Airliner (two 1,900 h.p. ASh-82T engines).

DIMENSIONS (Il-14M).—
Same as Il-14P except :—
Length 22.31 m. (73 ft. 3½ in.).
WEIGHTS (Il-14P).—
Weight empty 12,080 kg. (26,630 lb.).
Weight loaded 16,500 kg. (36,380 lb.).
WEIGHTS (Il-14M).—
Weight empty 12,250 kg. (27,000 lb.).
Weight loaded 17,250 kg. (38,030 lb.).
PERFORMANCE (Il-14P).—
Max. speed at S/L 396 km.h. (246 m.p.h.).
Max. speed at 2,400 m. (7,875 ft.) 430 km.h. (267 m.p.h.).
Cruising speed at 3,000 m. (9,850 ft.) 320 km.h. (199 m.p.h.).
Landing speed 135 km.h. (84 m.p.h.).
Rate of climb at S/L 318 m./min. (1,045 ft./min.).
Service ceiling 7,000 m. (23,000 ft.).
Range at 320 km.h. (199 m.p.h.) at 3,000 m. (9,850 ft.) 1,900 km. (1,180 miles).
Range at 260 km.h. (162 m.p.h.) at 3,000 m. (9,850 ft.) 3,200 km. (1,990 miles).
PERFORMANCE (Il-14M).—
Max. speed at S/L 382 km.h. (237 m.p.h.).
Max. speed at 2,400 m. (7,875 ft.) 416 km.h. (258 m.p.h.).
Max. cruising speed at 2,500 m. (8,200 ft.) 358 km.h. (222 m.p.h.).
Landing speed 135 km.h. (84 m.p.h.).
Rate of climb at S/L 288 m./min. (945 ft./min.).
Range 1,500 km. (930 miles).

THE IL-12.

NATO Code Name: "Coach."

The Il-12, which first flew in 1944, is still in service on medium-length routes with Aeroflot, C.S.A. (Czechoslovak Airlines) and L.O.T. (Polish Airlines). It is also used by the Soviet Air Force for glider-towing, paratroop and freight carrying.

TYPE.—Twin-engined Transport.

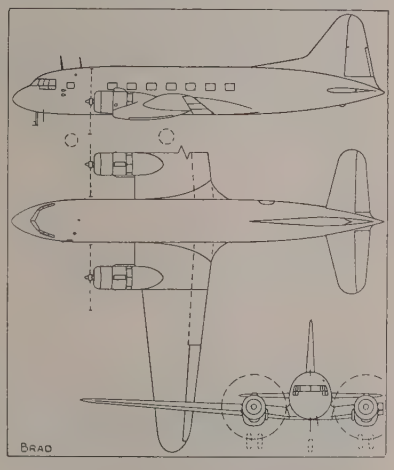
WINGS.—Low-wing cantilever monoplane. Two spar metal structure, with metal stressed skin covering. Ailerons in outer panels, with trim tab in starboard aileron only. Split trailing-edge flaps, divided into two at junction of outer panels and centre section. Wing de-icing by warm air ducted through oil coolers and thence to leading-edges. Wing area 100 m.² (1,076 sq. ft.).

FUSELAGE.—Oval all-metal semi-monocoque structure.

TAIL UNIT.—Cantilever monoplane type with single fin and rudder. May be seen with or without dorsal fin extension. Metal-clad fixed surfaces, control surfaces metal-framed, fabric-covered. Spring tab in rudder and elevators. Tailplane de-icing as for wings.

LANDING GEAR.—Retractable tricycle type. Single nose-wheel retracts rearwards into fuselage. Main wheel units, each with twin wheels, retract forward into engine nacelles. Detachable tail strut used during loading operations.

POWER PLANT.—Two ASh-82FNV fourteen-cylinder two-row radial air-cooled engines developing 1,775 h.p. for take-off at 2,400 r.p.m. Rated power 1,600 h.p. at 2,050 m. (6,730 ft.) and 1,350 h.p. at 5,540 m. (17,720 ft.). Four-blade metal constant-speed fully-feathering airscrews. Total fuel capacity 3,500 litres (1,435 Imp. gallons) in eight tanks, two in fuselage, two in centre section, two in each outer wing section.



The Ilyushin Il-12 Airliner.

ACCOMMODATION.—Crew of five, comprising pilot and co-pilot side-by-side, navigator and radio-operator on flight deck to rear of pilots, and stewardess. Accommodation for 27-32 passengers in air-conditioned main cabin. Standard version seats 27 in a row of nine single seats down the starboard side of cabin, and nine double seats down port side. Toilet compartment at rear.

EQUIPMENT.—Night and blind-flying equipment, two-way V.H.F. and full radio installations.

DIMENSIONS.—
Span 31.7 m. (104 ft.).
Length 21.31 m. (69 ft. 10¾ in.).
Height 8.07 m. (26 ft. 6 in.).
WEIGHTS AND LOADINGS (27-passenger version).—
Empty weight 11,110 kg. (24,495 lb.).
Payload 3,000 kg. (6,610 lb.).
Loaded weight 17,250 kg. (38,030 lb.).
Take-off power loading 4.76 kg./h.p. (10.7 lb./h.p.).
PERFORMANCE.—
Max. speed 365 km.h. (226 m.p.h.) at sea level.
370 km.h. (230 m.p.h.) at 500 m. (1,640 ft.).
385 km.h. (239 m.p.h.) at 1,000 m. (3,280 ft.).
407 km.h. (252 m.p.h.) at 2,500 m. (8,220 ft.).
Cruising speeds 325 km.h. (202 m.p.h.) at sea level.
335 km.h. (208 m.p.h.) at 1,000 m. (3,280 ft.).
350 km.h. (217 m.p.h.) at 2,500 m. (8,220 ft.).
345 km.h. (214 m.p.h.) at 3,000 m. (9,840 ft.).
Landing speed 145 km.h. (90 m.p.h.).
Take-off run 360 m.-520 m. (1,185 ft.-1,705 ft.).
Landing run 450 m. (1,475 ft.).
Single-engine ceiling 3,000 m. (9,840 ft.).
Range with 32 passengers 20 kg. (45 lb.) baggage each 1,250 km. (777 miles).
Range with 27 passengers 20 kg. (45 lb.) baggage each 2,000 km. (1,240 miles).
Range with 16 passengers (de luxe version) 3,000 km. (1,865 miles).



The Ilyushin Il-12 Airliner (two 1,775 h.p. ASh-82FNV engines).

KAMOV

NIKOLAI I. KAMOV.

N. I. Kamov is a well-known figure in the development of the Soviet Union's rotary-wing aeroplanes. He was active from the late 1920's until the beginning of World War II, and shortly after 1945 began to investigate the possibility of producing a lightweight helicopter of the "flying motor-cycle" type.

One of the first studies was the Ka-8, described in the 1951-52 edition of this Annual (under the designation K-17), though it was rather under-powered and was not a great success. It was developed into the Ka-10, of which twelve examples were built and tested during 1950. A later modification was the Ka-10M with twin fins and rudders.

More recently, Kamov and his design team, under chief engineer Vladimir Barshevskii, have built the two-seat Ka-15 and the four-seat Ka-18. The latter is now in quantity production for agricultural, mail and freight duties.



The Ka-15 Helicopter (255 h.p. AI-14R engine).

THE KA-10.

NATO Code Name: "Hat".

TYPE.—Single-seat Light Utility helicopter.
ROTORS.—Two contra-rotating three-blade rotors of laminated wood and plastic, fully articulated in flapping and drag planes.
FUSELAGE.—Simple tubular framework, carrying engine, rotor supports, seat, and attachments for tail unit.
TAIL UNIT.—Single angular vertical stabilising surface.
LANDING GEAR.—Twin pontoons.
POWER UNIT.—One AI-4G engine giving 55 h.p. at 4,500 r.p.m.
ACCOMMODATION.—Single open seat behind engine.
DIMENSIONS.—
Rotor diameter 6.13 m. (20 ft. 1 in.).
Length 3.9 m. (12 ft. 9½ in.).
Width 1.97 m. (6 ft. 5½ in.).
Height 2.5 m. (8 ft. 2½ in.).
WEIGHT.—
Weight loaded 375 kg. (827 lb.).
PERFORMANCE.—
Max. speed 116 km.h. (72 m.p.h.).
Hovering ceiling 300 m. (985 ft.).
Absolute ceiling 2,500 m. (8,200 ft.).
Range 195 km. (120 miles).
Max. endurance 2 hrs.

THE KA-10M.

The Ka-10M is a slightly modified version of the Ka-10. The chief difference is that the single fin of the latter has been replaced by twin, rounded vertical stabilising surfaces. Several helicopters of this type were demonstrated during 1950, including one in the Navy Day celebrations.

THE KA-15.

NATO Code Name: "Hen".

The Ka-15 was reported in 1956. It is a two-seat helicopter, developed with the aid of experience gained with earlier designs.

In 1958, a Ka-15 piloted by Vinnitsky set up a new international helicopter speed record of 162.784 km.h. (101.15 m.p.h.) over a 100 km. (62 mile) closed circuit.

TYPE.—Light Utility helicopter.
ROTORS.—Two contra-rotating fully-articulated three-blade rotors, similar to those of the Ka-10M, of wood construction. Plywood covered and filled with foam plastic.
FUSELAGE.—Metal frame with plywood covering, stressed skin at rear. Large transparent nose portion.
TAIL UNIT.—Tailplane above fuselage decking, with two end-plate vertical fins.
LANDING GEAR.—Four-wheel forward unit. Small tail bumper.
POWER PLANT.—One 255 h.p. AI-14R nine-cylinder radial engine, with single-speed supercharger and cooling fan.
ACCOMMODATION.—Two side-by-side seats.
DIMENSION.—
Rotor diameter 9.97 m. (32 ft. 8½ in.).
PERFORMANCE.—
Max. speed 150 km.h. (93 m.p.h.).
Cruising speed 125 km.h. (78 m.p.h.).
Hovering ceiling 680 m. (2,230 ft.).
Service ceiling 3,000 m. (9,840 ft.).
Normal endurance 2 hr. 30 min.
Max. endurance 4 hr.

THE KA-18.

NATO Code Name: "Hog".

The Kamov Ka-18 is a four-seater development of the Ka-15, with redesigned and lengthened forward fuselage. It first flew in mid-1957 and is now in series production. It will be used for a variety of rôles, including passenger, freight and mail-carrying, geographic survey, and agricultural duties with external hoppers and spray-bars.

The fuselage of the Ka-18 consists of a welded steel-tube structure, covered with light-alloy skin and with a monocoque tail-boom. The engine and rotor system are similar to those of the Ka-15.

DIMENSIONS.—
Rotor diameter 9.97 m. (32 ft. 8½ in.).
Fuselage length 7.0 m. (23 ft. 0 in.).
Height to top of rotor head 3.32 m. (10 ft. 10 in.).
WEIGHTS.—
Weight empty, equipped 1,023 kg. (2,255 lb.).
Payload 200-300 kg. (440-660 lb.).
Weight loaded 1,310 kg. (2,888 lb.).
PERFORMANCE.—
Max. speed 150 km.h. (93 m.p.h.).
Cruising speed at 490 m. (1,600 ft.) 110 km.h. (68 m.p.h.).
Normal range with 20 min. reserve 170-200 km. (105-124 miles).
Max. range (internal tanks, 177 litres=39 Imp. gallons fuel) 400 km. (248 miles).
Max. range (with additional 136 litre=30 Imp. gallons long-range tanks) 700 km. (435 miles).

KUZAKOV

M. A. KUZAKOV.

M. A. Kuzakov is a glider designer, who has been studying "all-wing" designs since the 1930's. In 1956 there was reported a motorised version of the MAK-15 training glider.

THE MAK-15MP.

TYPE.—Light powered glider for aerobatic and training use.
WINGS.—Gull-wing type, of wood and fabric construction. Joined by broad fillets to the tailplane.
FUSELAGE.—A "pod" houses the motor and the pilot. A relatively small rear section connects with the tail unit.
TAIL UNIT.—Tailplane integral with wing roots. Triangular fin and large rudder.
LANDING GEAR.—Single wheel under fuselage, skids at wing-tips.
POWER PLANT.—One 25 h.p. Polyakov five-cylinder radial two-stroke engine.
ACCOMMODATION.—One seat under a large transparent moulded canopy.
WEIGHTS.—
Weight loaded 311 kg. (685 lb.).
PERFORMANCE.—
Max. speed 150 km.h. (93 m.p.h.).



The Kuzakov MAK-15MP Powered Glider (25 h.p. Polyakov engine).

MATVIEYEV

In October, 1957, the existence of a Russian V.T.O. test rig similar in appearance to the Rolls-Royce "Flying Bedstead" of 1954 was revealed. Subsequently, it was announced that the test rig was designed by a team of engineers named Rafaelianc, Kwashinin and Lipshyn, under the leadership of Prof. Matvieyev, and that many Soviet designers are working on V.T.O. aircraft, including airliners, using similar techniques.

THE TURBOLOT.

The Turbolot V.T.O. test rig has a steel-tube frame, with a landing gear consisting of four small castoring wheels. The large axial-flow turbojet, possibly a Mikulin RD-3, is mounted vertically in the middle of the frame, with fuel tanks to each side and an enclosed cockpit, said to be similar to that of the MiG-17 fighter in front.

Control is achieved by differential air jets at the extremities of the four steel-tube arms projecting from the frame, in the manner pioneered by the Rolls-Royce "Flying Bedstead."

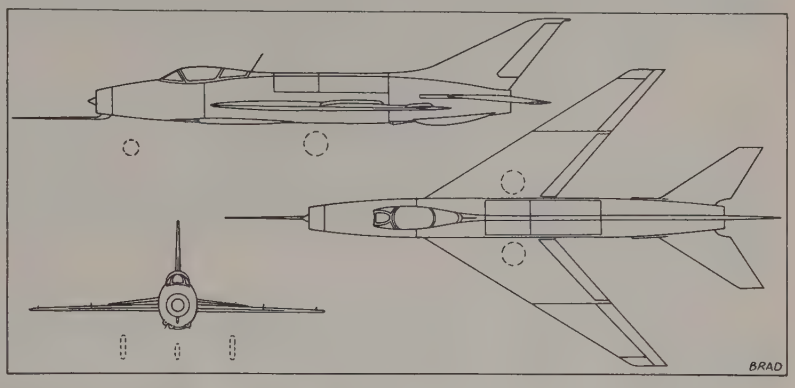
MIG

ARTEM MIKOYAN AND MIKHAIL GUREVICH.

Mikoyan and Gurevich, a mathematician, have collaborated for many years in the design of high-performance fighter aircraft. They were responsible for the first of the really-modern Soviet jet-fighters, the MiG-15, which proved itself in action in Korea.

The production MiG-15 began to appear in squadron service in numbers in 1949, and by 1952 it was flying in many satellite air forces. Many hundreds—probably some thousands—of MiG-15's have been made available for their use.

The MiG-17, a progressive development of the MiG-15, appeared in Soviet squadrons in 1953 or 1954, and this has been followed by the supersonic MiG-19 which appeared in 1955, and the new highly-supersonic MiG-21.



The MiG-21 Supersonic Fighter (provisional drawing).



A formation of MiG-19 Single-seat Swept-wing Fighters.

THE MIG-21.
NATO Code Name: "Faceplate".

Latest Soviet fighter to be identified with Mikoyan is the MiG-21, which was first shown publicly at Tushino in 1956. Its wings are swept at an angle of about 57°, and it appears to be powered by a single turbojet. This has been estimated to develop about 8,000 kg. (18,000 lb.) s.t. with afterburning. A bulge under the rear fuselage may house an auxiliary rocket motor. Armament is believed to consist of three 37 mm. cannon and a number of 50 mm. air-to-air rockets in underwing pods.

The following data are estimated.

DIMENSIONS.—
Span 8.3 m. (27 ft.).
Length 14.0 m. (46 ft.).

WEIGHTS.—
Weight empty 5,450 kg. (12,000 lb.).
Weight loaded over 9,000 kg. (20,000 lb.).

PERFORMANCE.—
Max. speed Mach 1.5-2.0.
Service ceiling 18,300 m. (60,000 ft.).

THE MIG-19.
NATO Code Name: "Farmer."

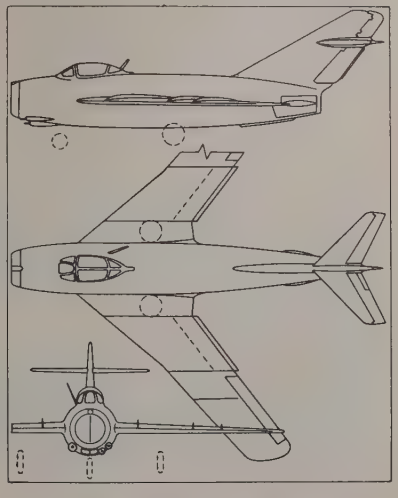
The MiG-19 was first seen publicly in a formation of 48 in the 1955 Soviet Aviation Day Display at Tushino, and is now in large-scale service with the Soviet Air Force. It is also being built in Czechoslovakia.

Fighters of this type can be zero-launched from ramps with the aid of large external booster rockets.

The data given below are in most cases estimates.

TYPE.—Single-seat Interceptor Fighter.

WINGS.—Cantilever monoplane with slight anhedral and swept at 55° at 25% of chord. Single fence on each wing at mid-span.



The MiG-17 Single-seat Fighter.

FUSELAGE.—Circular section with straight top line and slightly curved ventral line. Air intake in nose and twin jet exits under rudder. Sideways-opening air-brake on each side of fuselage aft of wing.

TAIL UNIT.—Swept horizontal and vertical surfaces. All-moving tailplane.

LANDING GEAR.—Tricycle type with inward-retracting main wheels.

POWER PLANT.—Two axial-flow turbojets with reported thrust of 4,000 kg. (8,818 lb.) each. Latest version has central shock-cone in intake, possible housing radar. Two or four 400 litre (88 Imp. gallon) external tanks can be carried on underwing pylons.

ACCOMMODATION.—Single cockpit well forward above nose.

ARMAMENT.—Two 37 mm. cannon in bottom of fuselage nose. One 23 mm. cannon in each wing-root. Provision for underwing pods, each containing 8 × 50 mm. rockets, or two air-to-air missiles.

DIMENSIONS.—
Span 9.75 m. (32 ft.).
Length 11.43 m. (37 ft. 6 in.).

WEIGHT.—
Weight loaded 9,000 kg. (19,840 lb.).

PERFORMANCE.—
Max. level speed reported as Mach 1.4.

THE MIG-17.
NATO Code Name: "Fresco A, B, C and D".

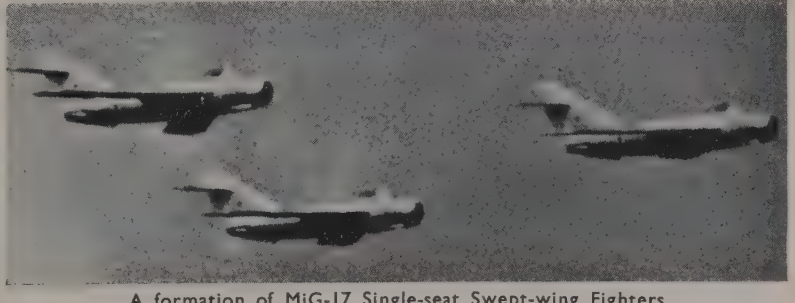
The MiG-17 is a development of the MiG-15, which it began to supersede in production in 1953. Externally it differs by having a slightly slimmer fuselage, rounded tips to more sharply-swept wings, and alterations to the tail unit.

In addition to Soviet production, the MiG-17 has been built in Poland, Czechoslovakia and China. It has been supplied to Afghanistan, Albania, Bulgaria, Egypt, Hungary, Indonesia, North Korea, Rumania and Syria.

Five versions of the MiG-17 have been distinguished. They are :—

"Fresco A." Initial production model with VK-1 turbojet (2,700 kg.= 5,955 lb. s.t.) and rear fuselage dive brakes.

"Fresco B." Dive brakes forward, near wing trailing-edge.



A formation of MiG-17 Single-seat Swept-wing Fighters.



MiG fighters of the Egyptian Air Force. In the foreground are three MiG-17's.

"Fresco C." Most widely-used version. Similar to "A"; but with afterburning VK-1A turbojet (3,450 kg.= 7,590 lb. s.t.) and underwing fuel tanks.

"Fresco D." Radar-equipped all-weather fighter version of "C," with slight nose modifications. Dive brakes are at rear fuselage. No afterburner.

"Fresco E." Similar to "D" but with afterburner.

TYPE.—Single-seat Interceptor Fighter.

WINGS.—Mid-wing all-metal cantilever monoplane. Sweepback 42°. The centre-section leading-edge is more sharply swept than the outer panels. There are three boundary-layer fences on each wing, though early examples had two only. Wing area 24.6 m.² (265 sq. ft.).

FUSELAGE.—Generally similar to that of the MiG-15. The rear air brakes are bulged and break the surface of the fuselage.

TAIL UNIT.—Sharply-swept surfaces, the rudder and fin being of higher aspect ratio than those of the MiG-15.

LANDING GEAR.—Retractable tricycle type.

POWER PLANT ("Fresco C").—One Klimov VK-1A turbojet engine, developing 3,450 kg. (7,590 lb.) s.t. with after-burning. Normal fuel load in internal tanks 1,650 litres. A 400 litre (88 Imp. gallon) external tank may be fitted at half-span on each wing.

ACCOMMODATION.—Single pressurised cockpit.

ARMAMENT.—One 37 mm. Nudelmann cannon and two 23 mm. cannon said to be of NR type. A single 23 mm. gun package may be installed in some instances at the wing tank position, to supplement the standard fuselage guns. Provision for four underwing packs of 8 × 50 mm. air-to-air rockets or a total of 500 kg. (1,100 lb.) of bombs.

EQUIPMENT.—RS I-6K radio transmitter; RS I-6M-1 receiver; IFF transponder; radio compass; radio altimeter; and marker beacon receiver.

DIMENSIONS (approx.).—
Span 10.96 m. (36 ft.).
Length 11.20 m. (36 ft. 9 in.).
Wing area 25.8 m.² (277.6 sq. ft.).

WEIGHTS ("Fresco C").—
Empty weight 4,470 kg. (9,850 lb.).
Normal loaded weight 5,990 kg. (13,200 lb.).
Max. loaded weight 7,030 kg. (15,500 lb.).

PERFORMANCE ("Fresco C").—
Max. speed Mach 0.975.
Landing speed 211 km.h. (127 m.p.h.).
Rate of climb 3,200 m./min. (10,500 ft./min.).
Service ceiling 17,400 m. (57,100 ft.).
Normal range 820 km. (510 miles).
Range with external tanks 1,860 km. (1,160 miles).

THE MIG-15.
NATO Code Name: "Fagot."

Although superseded in production by the MiG-17 and MiG-19, the MiG-15 and its variants remain in service in the air forces of Russia, Bulgaria, China, Czechoslovakia, East Germany, Egypt, Hungary, North Korea, Poland, Rumania and Syria.

TYPE.—Single-seat Jet Fighter.

WINGS.—Mid-wing cantilever monoplane. Sweepback at leading-edge 42°. Dihedral –3°. Thickness/chord ratio 11 per cent constant. All-metal light alloy stressed-skin structure with two main I-section spars. Hydraulically-operated Fowler split flaps. Ailerons have both mass and sealed aerodynamic balances. Two fences on each wing. Gross wing area 23.7 m.² (255 sq. ft.).

FUSELAGE.—Semi-monocoque light alloy stressed-skin structure. In two main units, a forward assembly of nose and mid sections, and a rear section, joined by quick-release bolts at the rear wing spar attachment points: the rear fuselage being easily detachable for engine servicing. Air brakes on rear fuselage.

TAIL UNIT.—Cantilever monoplane type with high-mounted tailplane. Sweepback on fin and tailplane leading-edges 42°. Tailplane incidence adjustable on ground only. Elevators and rudders of stressed light alloy construction. Electrically-operated trim-tab in port elevator. Both upper and lower rudders mass-balanced. Tailplane span 4.5 m. (14 ft. 10 in.).

LANDING GEAR.—Retractable tricycle. Air-oil shock absorbers. Main wheels, with levered suspension, raised inward, nose wheel forward. Hydraulic retraction, with emergency pneumatic system. Hydraulic brakes.

POWER PLANT.—One RD-45 centrifugal-flow turbojet engine (2,740 kg.=5,450 lb. s.t.). Bifurcated nose air-inlet. Fuel tanks in mid fuselage section between the divided air intake ducts. Total internal fuel capacity 1,250 litres (330 U.S. gallons). Drop tanks 600 litres (160 U.S. gallons) each may be carried, one under each wing.

ACCOMMODATION.—Pressurised cockpit forward of wing leading-edge with sliding canopy. Max. pressure 4.2 lb./sq. in. from 26,000 ft. (7,930 m.) up. Oxygen



The MiG-15UTI Two-seat Trainer (RD-45 turbojet engine).



The MiG-15*bis* Single-seat Fighter (VK-1 turbojet engine).

system is provided for emergency use. Ejection seat with automatic release, not fitted in early examples, is now standard.

ARMAMENT.—Standard armament consists of two NS (Nudelmann-Suranov) 23 mm. cannon below port side of nose and one 37 mm. N (Nudelmann) cannon below starboard side. Guns mounted in a carriage which can be lowered for easy maintenance when a panel is removed. Gyro gun-sight. Rockets or two 1,000 bombs may be carried under wing.

DIMENSIONS.—
Span 10.10 m. (33 ft. 1½ in.).
Length 11.10 m. (36 ft. 4 in.).
Height 3.40 m. (11 ft. 2 in.).

WEIGHTS.—
Weight empty 3,780 kg. (8,320 lb.).
Weight loaded (combat) 5,120 kg. (11,270 lb.).
Max. loaded weight (with external fuel or bombs) 6,465 kg. (14,240 lb.).

PERFORMANCE.—
Max. speed approx. 1.072 km.h. (670 m.p.h.).
Stalling speed 175 km.h. (109 m.p.h.).
Initial rate of climb 3,170 m./min. (10,400 ft./min.).
Service ceiling 15,550 m. (51,000 ft.).

THE MIG-15*bis*.

TYPE.—Single-seat Jet Fighter.

CONSTRUCTION.—As for standard MiG-15, but wings of MiG-15*bis* have perforated flaps.

POWER PLANT.—One VK-1 centrifugal-flow turbojet engine (2,700 kg.=5,955 lb. s.t.).

FUEL.—T-77 kerosene. Internal capacity 1,410 litres (310.2 Imp. gallons) external fuel 490 litres (108 Imp. gallons).

ACCOMMODATION.—Pilot's seat below rear-sliding canopy.

ARMAMENT AND EQUIPMENT.—One 37 mm. cannon with 40 rounds on starboard side of lower front fuselage: two 23 mm. NS cannon each with 80 rounds on port side. Gyro gun sight. Attachments for auxiliary fuel tanks or 550 kg. (1,100 lb.) of bombs.

DIMENSIONS.—
Span 10.1 m. (33 ft. 1½ in.).
Length 11.1 m. (36 ft. 4 in.).
Wing area 23.7 m.² (255 sq. ft.).

WEIGHTS AND LOADINGS.—
Weight loaded 5,028 kg. (11,085 lb.).

PERFORMANCE.—
Max. speed between 1,100-1,200 km./hr. (684-746 m./hr.).
Stalling speed (clean) 210 km./hr. (131 m.p.h.).
Stalling speed (flap and L/G down) 190 km./hr. (118 m.p.h.).
Ceiling above 15,000 metres (49,200 ft.).
Endurance about 2 hours.

THE MIG-15UTI.

NATO Code Name: "Midget."

TYPE.—Two-seat conversion trainer developed from MiG-15.

CONSTRUCTION.—Similar to fighter type.

POWER PLANT.—One RD-45 turbojet engine (2,740 kg.=5,450 lb. s.t.).

ACCOMMODATION.—Pupil and instructor sit in tandem under long raised canopy.

ARMAMENT.—Guns not carried but fairings are retained.

DIMENSIONS.—
Span 10.10 m. (33 ft. 1½ in.).
Length 11.10 m. (36 ft. 4 in.).
Height 3.40 m. (11 ft. 2 in.).

PERFORMANCE.—
Similar to that of MiG-15.

MIL

MIKHAIL L. MIL.

M. L. Mil is a well-known worker in the field of rotating-wing aeroplanes. He has been connected with Soviet gyroplane and helicopter development since at least 1930, and in the thirties was collaborating with V. A. Kuznetsov and N. K. Skrzhinskii. His latest designs are influenced by the work of Boris N. Yurev, who directs much of the helicopter research in the U.S.S.R.

The Mi-1, which was designed in 1949, first flown in 1950 and was introduced into squadron service in 1951, was followed by the developed Mi-3 and, in 1953, by the Mi-4 in a number of variants. All of these types are widely used, both by Aeroflot and the Services.

The Mi-1 has been placed in production in Poland, under the designation SM-1.

Latest product of Mikhail Mil, announced in the Autumn of 1957, is the Mi-6 which is the largest passenger helicopter yet flown anywhere in the World. He has announced that turbine-powered versions of the Mi-1 and Mi-4 are under development.

THE MI-1.

NATO Code Name: "Hare."

There are four versions of this helicopter :—

Mi-1. Accommodation for pilot and three passengers.

Mi-1T. Accommodation for pilot and two passengers. Can be distinguished by two small horizontal stabilisers at rear of main tail-boom.

Mi-1NKh. Multi-purpose version, suitable for postal, ambulance and agricultural duties. NKh is an abbreviation of Narodno-Khozyaistvennyi (national economic). In series production.

In addition, a special sea-patrol and whale-spotting version of the Mi-1 has been produced, with four cylindrical collapsible floats. These floats are supplementary to the normal landing gear, the legs of which are longer than on standard Mi-1's. Tests carried out early in 1958 showed that this version is capable of alighting on and taking off from quite rough seas.

Mi-1U. At least one Mi-1 has been modified to have dual controls, to enable conversion training to be carried out.

TYPE.—Single-rotor General Purpose Helicopter.

ROTORS.—The three main blades are of mixed construction and are movable axially and horizontally. Change in the angle of incidence is effected by tilting the main rotor spider. The three-blade anti-torque rotor is driven by a shaft running through the rear fuselage boom.

FUSELAGE.—The main fuselage is a tubular-steel structure with metal covering. The tail boom is a semi-monocoque structure with ring frames and longerons.

LANDING GEAR.—Fixed tricycle type with steerable nosewheel. Brakes on main wheels. Auxiliary collapsible floats can be fitted.

POWER PLANT.—One 575 h.p. AI-26V seven-cylinder fan-cooled radial engine with horizontal crankshaft. Inclined gearbox drives shaft to main rotor and also to tail anti-torque rotor. Rotor brake fitted. The main fuel tank is at the rear of the aft engine firewall.

ACCOMMODATION.—Pilot's seat forward; bench for two (Mi-1T) or three (Mi-1) passengers at rear. Car-type door on each side.

EQUIPMENT.—Transmitter/receiver radio is in extreme front of nose. Radio altimeter and inverter are at rear of main fuselage and dipole aerials under the tail boom. Full night-flying equipment.

DIMENSIONS.—
Main rotor diameter 14.0 m. (45 ft. 11 in.).
Fuselage length 12.10 m. (39 ft. 8 in.).
Tail rotor diameter 2.5 m. (8 ft. 3 in.).
Overall height 3.3 m. (10 ft. 10 in.).

WEIGHTS.—
Weight empty 1,785 kg. (3,925 lb.).
Max. loaded weight 2,250 kg. (4,960 lb.).

PERFORMANCE (Polish-built SM-1).—
Max. forward speed 185 km.h. (115 m.p.h.).
Economical cruising speed 97 km.h. (60 m.p.h.).
Max. rate of climb 390 m./min. (1,280 ft./min.).
Time to 1,000 m. (3,280 ft.) 4 min.
Time to 3,000 m. (9,840 ft.) 12 min.
Hovering ceiling 3,000 m. (9,840 ft.).
Max. range 385 km. (240 miles).
Max. endurance 3 hr. 24 min.

THE MI-3.

The Mi-3 has been derived by improvement of the Mi-1 helicopter, with which it is externally almost identical. However, the three-blade rotor of the early type has now been replaced by an aerodynamically more efficient four-blade rotor, and the fuselage has been slightly modified. The Mi-3 can be equipped with two external panniers for casualties, freight, fuel, or agricultural chemicals.

A radio compass has now been installed, and UKF ultra short wave radio is carried. Some of the new navigational equipment is housed in a small blister under the tail-boom.

DIMENSIONS.—
Rotor diameter 14.3 m. (46 ft. 11 in.).
Fuselage length 12.1 m. (39 ft. 9 in.).
Height 3.3 m. (10 ft. 10 in.).

WEIGHTS.—
Weight empty 1,800 kg. (3,968 lb.).
Weight loaded 2,350 kg. (5,180 lb.).

PERFORMANCE.—
Max. speed 200 km.h. (124 m.p.h.).
Economical cruising speed 100 km.h. (62 m.p.h.).
Hovering ceiling 2,000 m. (6,561 ft.).
Absolute ceiling 4,500 m. (14,765 ft.).
Max. range 338 km. (210 miles).

THE MI-4.

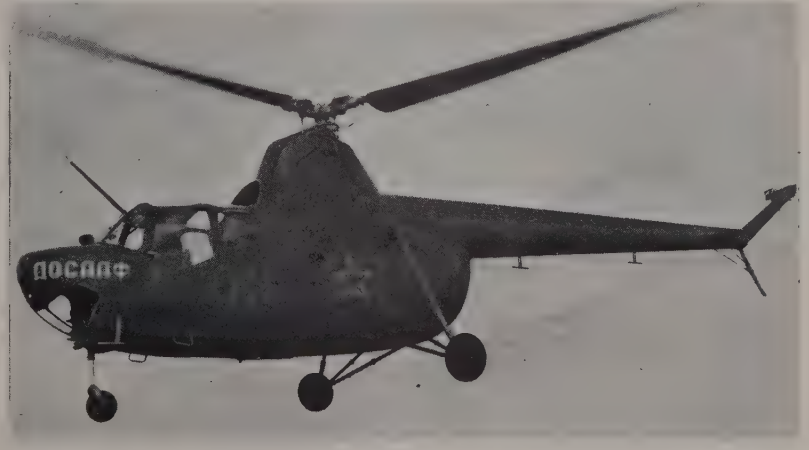
NATO Code Name: "Hound."

The data given below for this helicopter are thought to be reliable. A number of small variations in positioning of air intakes and design of landing gear struts may be found. The Mi-4 is used on many different duties in all parts of the Soviet Union, and the following variants have been identified.

Mi-4. Basic military version with under-fuselage gondola for navigator. Production said to have started in 1952.

Mi-4P. Passenger-carrying version in service with Aeroflot. Has comfortably-furnished cabin for 10 passengers and space for luggage to make up normal payload of 1,200 kg. (2,645 lb.). Externally, the Mi-4P can be distinguished by spatted wheels, square—instead of circular—cabin windows and deletion of under-fuselage gondola.

Mi-4S. Agricultural version. The ventral container can be used as a distribution point for sprays or dusts, and spray booms are fitted underneath the rotor. Maximum load is 1,000 kg.



The Mi-1 Helicopter (575 h.p. AI-26V engine).

(2,200 lb.) of dust or insecticide or 1,500 litres (330 Imp. gallons) of spray liquid, contained in a fuselage tank.

In addition, a fire-fighting development of the Mi-4 has been flown. It is probably closely related to the Mi-4S. An orientatable spray nozzle in the ventral "bath" container can direct extinguisher fluid at a fire, the supply being maintained by an electric pump.

An Mi-4 was specially modified for a number of international helicopter record flights. These included a height record of 6,048 m. (19,843 ft.) carrying a load of two metric tons on April 26, 1956. It was lightened by removing the ventral container and some of the external air scoops, by using smaller main wheels and by replacing the metal rear doors with fabric-covered doors.

The following data apply to the standard Mi-4.

TYPE.—Single-rotor General Purpose Helicopter.

ROTORS.—Four-bladed main rotor with hydraulic servo-control, and three-bladed anti-torque rotor at starboard side of tail boom.

FUSELAGE.—Motor mounted in extreme nose leaves rear available for freight or passengers. Access for bulky loads is through "clam-shell" doors under the tail boom attachment point.

UNDERCARRIAGE.—Two main wheels braced to fuselage sides, and two small nosewheels forward.

POWER PLANT.—One 1,700 h.p. ASh-82V air-cooled radial engine.

ACCOMMODATION.—Crew of two above and behind engine. Eleven passengers or about fourteen troops can be carried in the cabin. A GAZ-69 "Jeep," a 76 mm. anti-tank gun or two motor-cycle/sidecar combinations are typical military loads.

DIMENSIONS.—
Rotor diameter 21.0 m. (68 ft. 11 in.).
Fuselage length 16.27 m. (53 ft. 5 in.).
Height 5.18 m. (17 ft. 0 in.).



The Mi-4 General Purposes Helicopter (1,700 h.p. ASh-82V engine).

WEIGHTS.—
Normal max. weight 7,200 kg. (15,875 lb.).
Normal load 1,200 kg. (2,645 lb.).

PERFORMANCE.—
Max. speed 210 km.h. (130 m.p.h.) at 1,500 m. (4,920 ft.).
Cruising speed 195 km.h. (121 m.p.h.).
Service ceiling 4,880 m. (16,000 ft.).
Range 250 km. (155 miles) at 175 km.h. (109 m.p.h.) at 1,500 m. (4,920 ft.).

THE MI-6.

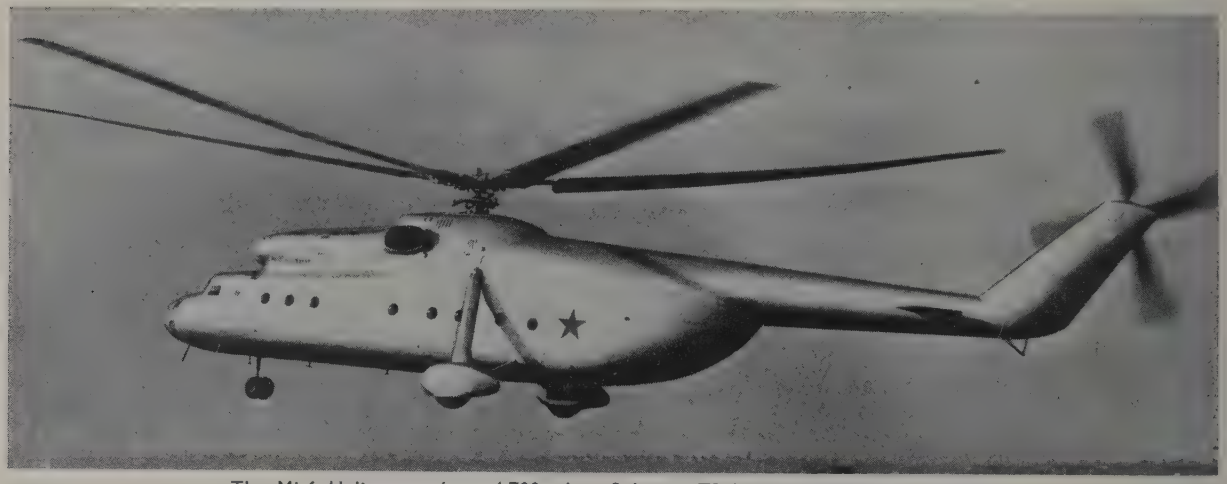
NATO Code Name: "Hook".

First announced in the Autumn of 1957, the Mi-6 is the largest helicopter currently flying anywhere in the world. Its layout is conventional and it is powered by two 4,700 h.p. Soloviev TB-2BM shaft-turbines, mounted above the cabin and driving a five-blade rotor with a diameter of around 33.5 m. (110 ft.).

In its latest form, it has two small wings mounted above the main landing gear struts, to off-load the rotor in flight.

The Mi-6 is stated to accommodate up to 120 passengers, with normal seating for 70-80 persons, and to be in series production. On October 30, 1957, the prototype established two international helicopter records, by lifting a load of 10,000 kg. (22,046 lb.) to a height of 2,432 m. (7,979 ft.) and by lifting to a height of 2,400 m. (7,874 ft.) a load of 12,000 kg. (26,964 lb.).

No further details were available at the time of writing.



The Mi-6 Helicopter (two 4,700 s.h.p. Soloviev TB-2BM shaft-turbine engines).

MYASISHCHEV

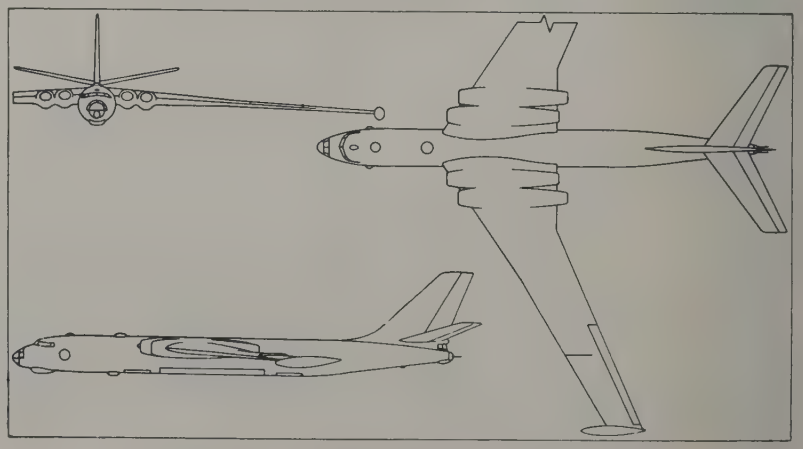
V. M. MYASISHCHEV.

Although Myasishchev's work has been little publicised, he is believed to have been in charge of his own design bureau for many years and to have been responsible for the development of several important types, including the four-jet bomber known in the west by the code name of "Bison."

Nominated in 1958 as a deputy of the Supreme Soviet, Myasishchev is reported to have designed a new long-range four-jet heavy bomber to replace the "Bison." This aircraft is believed to have been undergoing flight tests in the Spring of 1958; and one airframe was said to be earmarked as a flying test bed for the Soviet Union's first airborne nuclear propulsion engine.

NATO Code Name: "Bison."

This four-jet bomber first became known in the Summer of 1953 and was



The Four-jet Heavy Bomber which is code-named "Bison."



Two "Bison" Four-jet Heavy Bombers flying over Tushino in June, 1956.

first exhibited in the air on May Day, 1954. It is believed to be a product of Myasishchev's design bureau.

The "Bison" is of clean modern overall design though it lacks some of the refinements of modern Western bombers, and is believed to cruise at only comparatively low altitudes. Radio and radar aids are thought to be rather dated and the fire control system may not be a great advance on that of the Tu-4. However, the "Bison" is a formidable weapon on account of its speed, range and bomb-carrying capacity and production was thought to be running at around 10 a month in the Spring of 1958.

Quantitative data below are estimates.

TYPE.—Four-jet Long-range Heavy Bomber.

WINGS.—Mid-wing cantilever monoplane with some anhedral and with thickened centre-section to house engines. The centre-section has a straight trailing edge and a leading-edge more sharply swept than the outer wing panels, and its construction may be integral with the bomb-bay and part of the fuselage. The flaps are of the single slotted type. A single boundary-layer fence is fitted above each wing. Wing area 340 m.² (3,660 sq. ft.).

FUSELAGE.—All-metal semi-monocoque structure.

TAIL UNIT.—Cantilever swept tailplane with sharp dihedral. Swept fin and broad chord single rudder.

LANDING GEAR.—"Bicycle" main wheels housed fore and aft of the bomb bay. Outrigger supporting wheels are housed in the wing-tip fairings.

POWER PLANT.—Believed to comprise four Mikulin AM-3M turbojets, each developing approximately 8,700 kg. (19,180 lb.) s.t. at sea level. Provision for flight refuelling.

ACCOMMODATION.—Crew of eight or more. Glazed position in nose, three observation domes and a manned tail position.

ARMAMENT.—Forward dorsal and ventral turrets and tail turret. These are thought to be equipped with 23 mm. guns, two in each. Bomb load (normal) estimated at 4,500 kg. (9,900 lb.). Maximum load may be 9,000 kg. (19,800 lb.). The bomb-bay about 6 m (19.68 ft.) long.

EQUIPMENT.—Radome under nose and plentiful radio and radar aerials. Tail gunner's position appears to have radar warning.

DIMENSIONS (approx.).—
Span 52 m. (170 ft. 7 in.).
Length 49.5 m. (162 ft. 5 in.).

WEIGHTS.—
Loaded weight 160,000 kg. (352,750 lb.).

PERFORMANCE.—
Max. speed 900 km.h. (559 m.p.h.).
Service ceiling 13,700 m. (45,000 ft.).
Range 9,650 km. (6,000 miles).

SUKHANOV

This designer has produced an experimental glider named the Discoplan, with a disc-shaped wing, prior to producing a light jet-powered aircraft on the same lines. The prototype was demonstrated in flight at Tushino Airport early in 1958, and is said to be extremely manoeuvrable and docile.

THE DISCOPLAN.

This single-seat experimental glider has a wing that is almost circular in plan-form, with small ailerons inset in the trailing-edge. It has an enclosed, streamlined cabin mounted under the leading-edge of the wing. The landing gear comprises two non-retractable wheels braced to the cabin and a small tail-skid at the base of the rudder-post.



The Sukhanov Discoplan.

Tail controls comprise a conventional fin and rudder mounted above the wing trailing-edge, with a horizontal tailplane and elevators at the tip, surmounted by an additional vertical stabilising surface. The wing spans only 3.5 m. (11 ft. 6 in.), with an area of 10 m.² (107.6 sq. ft.). Loaded weight is 250 kg. (550 lb.) and limiting maximum speed 130 km.h. (81 m.p.h.).

SUKHOI

PAVEL OSIPOVICH SUKHOI.

Sukhoi is not well-known. He helped to design the Ant-25 and had a share in the construction of the "Rodina" before the last war and his Su-2 attack aeroplane was used in the war. He was responsible for one of the jet aircraft displayed in the 1947 Soviet Aviation Day Display.

Nearly a decade later, on June 24, 1956, there appeared at Tushino three delta-wing experimental fighters from Sukhoi's design offices. They appear to represent three modifications of a basic design and are described separately hereafter.

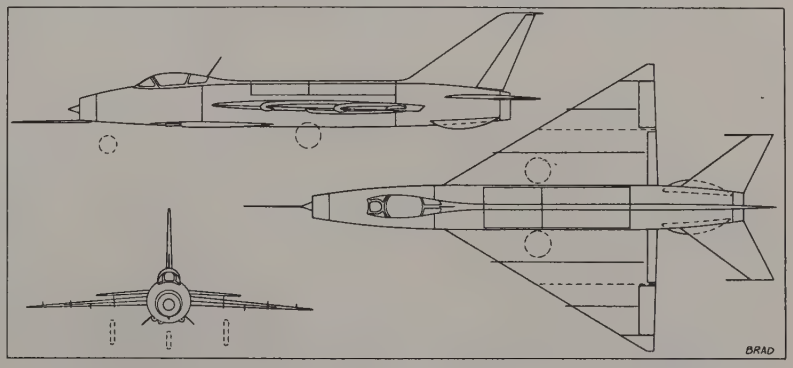
THE SUKHOI DELTA.
NATO Code Name: "Fishbed A."

The "Fishbed A" has a long tubular fuselage and delta wings with a leading-edge sweepback of approximately 60°, set in a mid or low-mid position. The wing-tips are pointed. The tail unit is conventional but the tailplane is noteworthy in having large forward fillets extending almost to the wing trailing edge. There is a bulge under the rear fuselage, possibly housing a rocket engine, and "Fishbed A" appears to have an air intake centre-body.

Span is approximately 7.5 m. (24 ft. 7 in.) and the length 14.6 m. (48 ft.). Loaded weight is estimated at around 8,500 kg. (18,750 lb.). The power plant is thought to be an axial-flow turbojet giving an output of some 5,000 kg. (11,000 lb.) s.t., perhaps increased by use of an afterburner. The performance may include a top speed of Mach 1.7 at 11,000 m. (36,000 ft.).

NATO Code Name: "Fishbed B."

The "Fishbed B" is rather similar to the "A" variant but has blunted wing-tips. The tailplane lacks the leading edge extensions of the "Fishbed A".



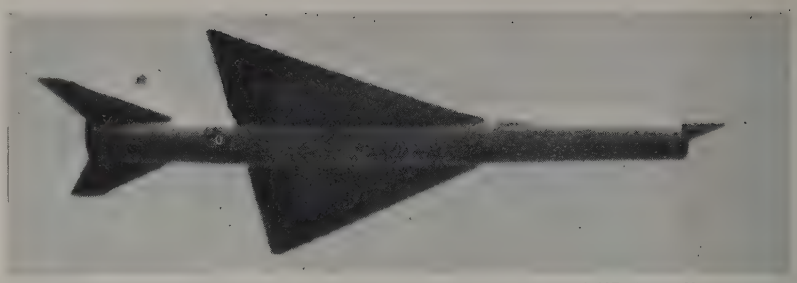
The Sukhoi Delta-wing Monoplane which is code-named "Fishbed B." (Provisional drawing).

According to U.S. Navy sources, this aircraft has three boundary-layer fences above each wing and a rack for external stores under each wing.

NATO Code Name: "Fishpot."

This aeroplane, which is believed to be in production for the Soviet Air Force as a single-seat all-weather fighter, appeared at the same display in 1956 as the two "Fishbeds". It is distinguished from them by a conical body at the top of the air intake orifice, probably housing fire-control radar equipment. It is believed to be powered by a single turbo-jet engine developing about 10,000 kg. (22,000 lb.) s.t., giving it a maximum speed in excess of Mach 2.

Approximate dimensions include a span of 7.6 m. (25 ft.), length of 15.2 m. (50 ft.) and tailpipe diameter of 1.3 m. (4 ft. 4 in.).



The Sukhoi Delta-wing Fighter which is code-named "Fishpot."

This particular aircraft is the subject of the illustration above.

TUPOLEV

ANDREI NIKOLAEVICH TUPOLEV.

A. N. Tupolev still holds an important place in the Russian aeronautical field. Born in 1888, he is apparently still the active head of an important design establishment; for much of his life he has been connected with the TsAGI and TsKB, and designers such as Sukhoi and Petlyakov have been his pupils and collaborators. In March, 1952, Tupolev and thirteen co-workers were awarded a Stalin Prize of 150,000 roubles for "new work in aircraft construction."

Post-war jet designs attributed to Tupolev have included a light twin-jet straight-wing bomber of 1948, the Tu-14, a later development bearing the NATO code name "Bosun," the Tu-16, better known as the "Badger," the Tu-104 twin-jet transport derived from the "Badger" which created such World-wide interest on its first appearance outside the Iron Curtain in the Spring of 1956, and the Tu-110, a four-jet version of the Tu-104.

THE TU-114 ROSSIYA (RUSSIA). NATO Code Name: "Cleat".

Largest and heaviest commercial airliner yet flown, the Tu-114 was completed in the Autumn of 1957, at the time of the 40th anniversary of the Russian Revolution. It is a civil counterpart of the Tu-95 "Bear" bomber, with the same wing, tail-unit, landing gear, turboprop engines and other components. Two versions have been announced.

Tu-114. Original version with accommodation for up to 220 passengers and normal seating for 120 persons.

Tu-114D. Basically similar to Tu-114, but with slimmer fuselage. Intended to carry a small number of passengers, mail and urgent freight over very long distances.

The prototype Tu-114D made a non-stop 8,500 km. (5,280 mile) flight from Moscow to Irkutsk and back at an average speed of 800 km.h. (497 m.p.h.) and at altitudes between 10,000 and 12,200 m. (33,000-40,000 ft.) in the Spring of 1958. The return flight encountered headwinds of up to 200 km.h. (125 m.p.h.), but sufficient fuel is said to have remained after landing for the aircraft to have flown a further 1,500-2,000 km. (930-1,240 miles).

The following data refer specifically to the Tu-114.

TYPE.—Four-engined Airliner.

WINGS.—Cantilever low-wing monoplane. Sweepback 35°. Aspect ratio 10.4. All-metal two-spar structure. All-metal hydraulically-powered ailerons and Fowler-type flaps. Trim-tabs in ailerons. Spoilers in top surface of wing forward of inboard end of ailerons. Two boundary layer fences on top surface of each wing. Thermal anti-icing system in leading edges. Wing area 280 m.² (3,013.9 sq. ft.).

FUSELAGE.—All-metal semi-monocoque structure of circular section.

TAIL UNIT.—Cantilever monoplane type, with sweepback on all surfaces. Hydraulically-powered rudder and elevators. Trim-tabs in rudder and elevators. All-metal structure.

LANDING GEAR.—Retractable tricycle type. Main units consist of four-wheel bogies. Twin nose-wheels. All units retract rearward, main units into nacelles built on to wing trailing-edge. Retractable tail bumper consisting of two small wheels.

POWER PLANT.—Four Kuznetsov NK-012M or 022K turboprop engines, each developing 12,000 h.p. plus 1,200 kg. (2,645 lb.) of jet thrust, and driving eight-blade contra-rotating reverse-pitch airscrews, diameter 5.6 m. (18 ft. 4½ in.). Total of 80,000 kg. (176,370 lb.) of fuel in wing tanks.

ACCOMMODATION.—Crew of ten to fifteen, including pilot, co-pilot, navigator, flight engineer, radio operator, and a minimum of three stewards and two cooks. Accommodation for up to 220 passengers with mainly eight-abreast seating. For long ranges, normal accommodation for 120 passengers in mixed six-abreast and four-abreast seating. Typical 170-seat layout has forward toilets and stewards' seats in compartment between flight deck and front cabin, latter seating 41 persons in six-abreast seats. Next is a small compartment for coat stowage in line with inboard airscrews; followed by a centre (restaurant) cabin for 48 persons in six-abreast pullman-type seats; the galley serving compartment; a small compartment containing stairs to the lower-deck kitchen and three seats; four "roomettes," each with two divans and one folding bunk or six seats; the rear cabin containing 54 seats in six-abreast rows; a coat stowage compartment; the entrance compartment with passenger door on port side; port and starboard washing and powder rooms; and finally four toilets. Two electric lifts connect lower-deck kitchen with serving area. Pressurised cabin is 47 m. long and 3.7 m. in diameter (154 ft. 2 in. × 12 ft. 4 in.). Volume of cabin 465 m.³ (16,420 cub. ft.). Volume of two under-floor pressurised freight holds 70 m.³ (2,472 cub. ft.). Pressure differential of 41.0 kg./m.² (8.4 lb./sq. ft.), giving equivalent of sea level at up to 6,000 m. (20,000 ft.) and equivalent of 2,500 m. (8,000 ft.) above that.

DIMENSIONS.—
Span 54.0 m. (177 ft. 2 in.).
Length 47.2 m. (154 ft. 10 in.).
Height 11.8 m. (38 ft. 8½ in.).

WEIGHTS.—
Weight empty 85,400 kg. (188,274 lb.).
Fuel 80,000 kg. (176,370 lb.).
Oil 3,000 kg. (6,614 lb.).
Crew (15) 1,350 kg. (2,976 lb.).



The Tu-114 Rossiya Airliner (four 12,000 s.h.p. Kuznetsov NK-012M turboprop engines).



The Tu-110 Airliner (four Lyulka turbojet engines).

Payload 18,000 kg. (39,683 lb.).
Max. take-off weight 187,750 kg. (413,917 lb.).
Max. landing weight 125,000 kg. (275,573 lb.).
Wing loading 670 kg./m.^{2} (137 lb./sq. ft.).
Power loading 3.6 kg./h.p. (7.94 lb./h.p.).

PERFORMANCE.—
Max. cruising speed at 9,000 m. (29,500 ft.) 910 km.h. (565 m.p.h.).
Max. cruising speed at 10,000 m. (32,800 ft.) 855 km.h. (531 m.p.h.).
Take-off speed at max. weight 272 km.h. (170 m.p.h.).
Landing speed 205 km.h. (125 m.p.h.).
Time to 10,000 m. (32,800 ft.) 36.5 min.
Service ceiling 10,400 m. (34,120 ft.).
Take-off distance to 15 m. (50 ft.) (presumably field length) 2,850 m. (9,350 ft.).
Landing distance from 15 m. (50 ft.) with reverse pitch 1,800 m. (5,900 ft.).
Landing distance from 15 m. (50 ft.) without reverse pitch 2,650 m. (8,690 ft.).
Normal range 10,000 km. (6,214 miles).
Max. range 14,500 km. (9,010 miles).

THE TU-110.
NATO Code Name: "Cooker".

First shown at Vnukovo Airport, Moscow, in July, 1957, the Tu-110 is a four-jet version of the Tu-104, produced presumably because the twin-engined arrangement of the latter would be unacceptable to many airlines. The redesign was undertaken by G. C. Markov, deputy director of Tupolev's design bureau, and the prototype flew within 18 months of when this work started.

The fuselage has been lengthened by 1.22 m. (4 ft.) to provide accommodation for up to 100 passengers, and the wing span and area have been increased to cater for the greater loaded weight. The flap area has also been increased.

Normally the Tu-110 seats 100 persons in five-abreast rows, with a forward 30-seat cabin, 15-seat centre cabin and a rear cabin for 55 persons. The galley is between the flight deck and the forward cabin. Alternative layouts are for 50 *de luxe* or 78 first class seats. Volume of the freight hold is 28 m.^{3} (988 cub. ft.).

The four turbojet engines, mounted side-by-side in pairs in the wing roots, were developed by A. M. Lyulka and are believed to develop 5,200 kg. (11,455 lb.) s.t. each.

DIMENSIONS.—
Span 37.5 m. (123 ft. 0 in.).
Length 38.3 m. (125 ft. 9 in.).
Height 12.0 m. (39 ft. 4½ in.).

WEIGHTS (100-seat version).—
Payload 12,000 kg. (26,455 lb.).
Weight loaded approx. 79,380 kg. (175,000 lb.).

PERFORMANCE.—
Max. speed at 11,000 m. (36,000 ft.) 1,000 km.h. (620 m.p.h.).
Max. cruising speed 900 km.h. (559 m.p.h.).
Recommended cruising speed at 11,000 m. (36,000 ft.) 800 km.h. (497 m.p.h.).
Take-off distance 1,555 m. (5,100 ft.).
Range with 12,000 kg. (26,455 lb.) payload and 1 hr. reserves 3,100-3,300 km. (1,927-2,050 miles).

THE TU-104.
NATO Code Name: "Camel."

The Tu-104 is a passenger-carrying version of the Tu-16 ("Badger") medium bomber. A new main fuselage (but retaining the nose and flight compartment of the "Badger") is used but the wings (lowered from the mid to low-wing position), tail-unit (with tailplane lowered), landing gear and power plant (with derated civil engines) are all of basic Tu-16 design.

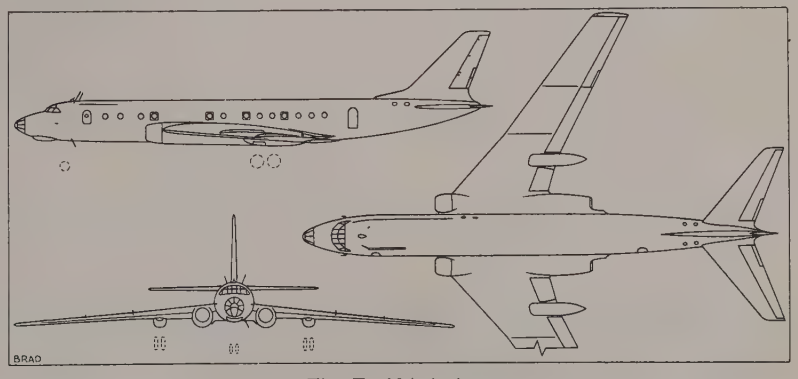
Three versions have been identified :—

Tu-104. Initial production version, with normal accommodation for 50 passengers.

Tu-104A. First shown at a Moscow airport in July, 1957. Basically similar to Tu-104, but with an alternative interior arrangement seating 70 passengers (16 first class, 54 tourist class) in three saloons, a galley equipped for hot meals, and improved engines modified from the Mikulin AM-3 by a design team under P. F. Zubets. These engines, designated RD-3M, develop 8,700 kg. (19,180 lb.) s.t. each. Maximum range is given as 3,000 km. (1,865 miles) at a cruising speed of 800 km.h. (497 m.p.h.).

Tu-104B. Basically similar to Tu-104A, but with accommodation for 100 passengers in five-abreast seating.

Design work on the Tu-104 was completed in 1954 and the first pre-production



The Tu-104 Airliner.



The Tu-104 Airliner (two Mikulin AM-3 turbojet engines).

aircraft (there was no prototype as such) made its first flight on June 17, 1955. This aircraft flew over Tushino at the Soviet Aviation Display in July, 1955.

Three examples of the Tu-104 visited the London Airport in March and April, 1956, and the type entered regular service with Aeroflot on September 15, 1956. At least 70 Tu-104's and Tu-104A's were believed to be in service with Aeroflot and the Polish and Czech national airlines by the Summer of 1958.

In September, 1957, a Tu-104A, set up eleven international records, including a closed-circuit distance record of 2,002.6 km. (1,244.3 miles); a speed record of 970.821 km.h. (603.24 m.p.h.) over a 1,000 km. (621 mile) closed circuit with a 10,000 kg. (22,046 lb.) payload ; a speed record of 897.498 km.h. (557.68 m.p.h.) over a 2,000 km. (1,242 m.p.h.) closed circuit with a 2,000 kg. (4,410 lb.) payload ; and a height record of 11,221 m. (36,814 ft.) carrying a 20,000 kg. (actually 20,055 kg.=44,213 lb.) payload.

TYPE.—Twin-jet Airliner.

WINGS.—Low-wing cantilever monoplane. Aspect ratio 6.5. Sweepback inboard of first wing fence 40° 30′ outboard 37° 30′. Thickness/chord ratio 12%. Moderate anhedral. All-metal structure. Manually-operated all-metal ailerons. Fowler-type slotted flaps are split by nacelles housing main landing gear units when retracted. Thermal de-icing of leading-edge. Gross wing area 188 m.² (2,024 sq. ft.).

FUSELAGE.—Circular section all-metal structure. Maximum diameter about 3.4 m. (11 ft. 1½ in.).

TAIL UNIT.—Cantilever monoplane type. Tailplane attached directly to fuselage. All surfaces have 45° sweepback.

LANDING GEAR.—Retractable nose-wheel type. Main four-wheel bogie units retract backwards into special housings extending aft of trailing-edge. Twin-wheel nose unit is steerable and retracts backward into fuselage.

POWER PLANT (Tu-104).—Two Mikulin AM-3 turbojet engines believed to be rated at 6,750 kg. (14,850 lb.) s.t. each at S/L. Fuel in two tanks in each wing and two in fuselage. Total fuel capacity 34,000 litres (7,480 Imp.=8,970 U.S. gallons).

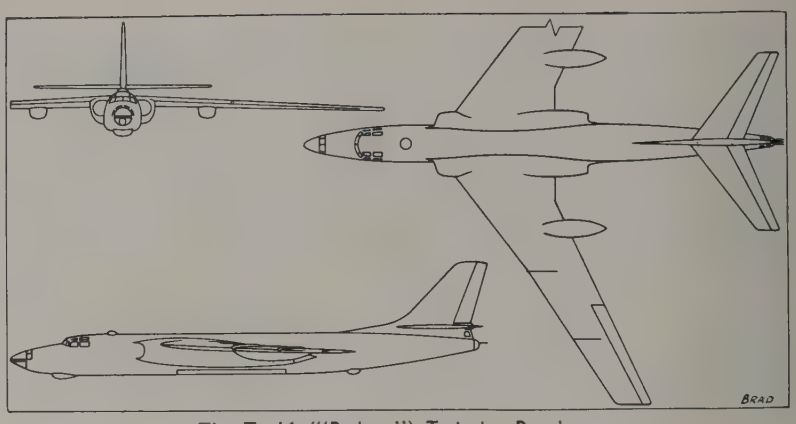
ACCOMMODATION.—Crew of two pilots, navigator, engineer and radio operator. Navigator's position in glazed nose compartment. Normal accommodation for 50 passengers, with a galley. Cabin is pressurised to a differential of 0.46 kg./cm.² (6.6 lb./sq. in.), but there are individual oxygen outlets at all seats.

DIMENSIONS.—
Span 35 m. (114 ft. 10 in.).
Length 37.05 m. (121 ft. 5 in.).
Height 12 m. (39 ft. 4½ in.).

WEIGHTS (Tu-104).—
Weight empty 19,450 kg. (42,880 lb.).
Normal loaded weight 55,000 kg. (121,250 lb.).
Max. loaded weight 70,000 kg. (154,325 lb.).

WEIGHTS (Tu-104A).—
Max. loaded weight 74,500 kg. (164,250 lb.).

PERFORMANCE (Tu-104).—
Max. speed 900 km.h. (559 m.p.h.).
Cruising speed 830 km.h. (515 m.p.h.). at 10,000 m. (32,800 ft.).
Climb to 10,000 m. (32,800 ft.) 15 min.
Absolute ceiling 12,000 m. (39,360 ft.).
Ceiling on one engine 5,000 m. (16,400 ft.).
Range (ICAO conditions) 3,200 km. (2,000 miles).



The Tu-16 ("Badger") Twin-jet Bomber.

THE TU-95.
NATO Code Name: "Bear."

This huge Tupolev bomber was first seen at Tushino in July, 1955 and has since entered service with units of the VVS.

No details of its construction have been released. But the Tu-114 airliner is believed to be virtually identical except for its new larger-diameter fuselage. As a result, the description of the wings, tail unit, landing gear and power plant of the Tu-114 can be taken to apply in general also to the "Bear," which certainly has the same Kuznetsov NK-012M type of turboprops.

There is a "chin" radar scanner, dorsal and ventral armament in turrets, and a manned tail gun position. Besides this last, there are two blisters on the rear fuselage, under the tailplane, either for observation or for extra armament. A braking parachute may be used for reducing the landing run.

The dimensions and performance of the "Bear" should be very similar to those of the Tu-114. Its loaded weight is believed to be about 154,220 kg. (340,000 lb.).



The Tu-95 Bomber (four Kuznetsov turboprop engines).

THE TU-16.
NATO Code Name: "Badger."

This Tupolev bomber, from which the Tu-104 civil airliner is derived, made its public appearance in some numbers in 1954. In July, 1955 a formation of 54 flew over Moscow an Aviation Day, and the Tu-16 has since become standard equipment in the Soviet Air Force. It is also reported to be in service with the Soviet Naval Air Force for anti-shipping duties, carrying underwing air-to-surface missiles. Quantitative data given below are estimates.

TYPE.—Twin-jet Medium Bomber.

WINGS.—High mid-wing cantilever monoplane with slight anhedral and with 37° of sweep.

FUSELAGE.—Long circular-section structure.

TAIL UNIT.—Swept cantilever type with slight tailplane dihedral.

LANDING GEAR.—Tricycle type. The main wheel bogies retract into special housings projecting beyond the wing trailing-edge.

POWER PLANT.—Probably two M-209 axial-flow twin-spool turbojets each with a military rating of about 8,200 kg. (18,040 lb.) s.t. at sea level. Provision for flight refuelling.

ACCOMMODATION.—Glazed nose and pilot's positions, manned tail position plus lateral observation blisters in the rear fuselage under the tailplane. Crew of 5-6

ARMAMENT.—Forward dorsal and rear ventral barbettes and two fixed forward firing guns in the sides of the lower fuselage. The tail position is provided with armament controlled by an automatic gun-ranging radar set. Bomb load about 4,500 kg. (9,920 lb.) delivered from bomb bay about 6.5 m. long.

EQUIPMENT.—Radio and radar aids probably include HF and VHF R/T equipment, as well as IFF and a radio compass and radio altimeter. A radome under the nose contains scanner type radar, probably an improved version of that fitted in the Il-28.

DIMENSIONS.—
Span 34 m. (111 ft. 6 in.).
Length 36 m. (118 ft.).
Wing area 186 m.² (2,002 sq. ft.).

WEIGHTS.—
Loaded weight 68,000 kg. (149,940 lb.).

PERFORMANCE.—
Max. speed at 13,700 m. (45,000 ft.) 1,000 km.h. (620 m.p.h.).
Range 6,950 km. (4,320 miles).

THE TU-14.
NATO Code Name: "Bosun."

This aircraft was mentioned in the U.S.A. in 1952 as a new light Russian bomber, with a higher performance than the Il-28. It is reported to be in service with the Soviet Naval Air Force for shore-based attack duties.

This bomber is closely related to the Tu twin-jet bomber of 1948, but has a radome, blunter tail, fin extension, and a sloping trailing-edge to the rudder.

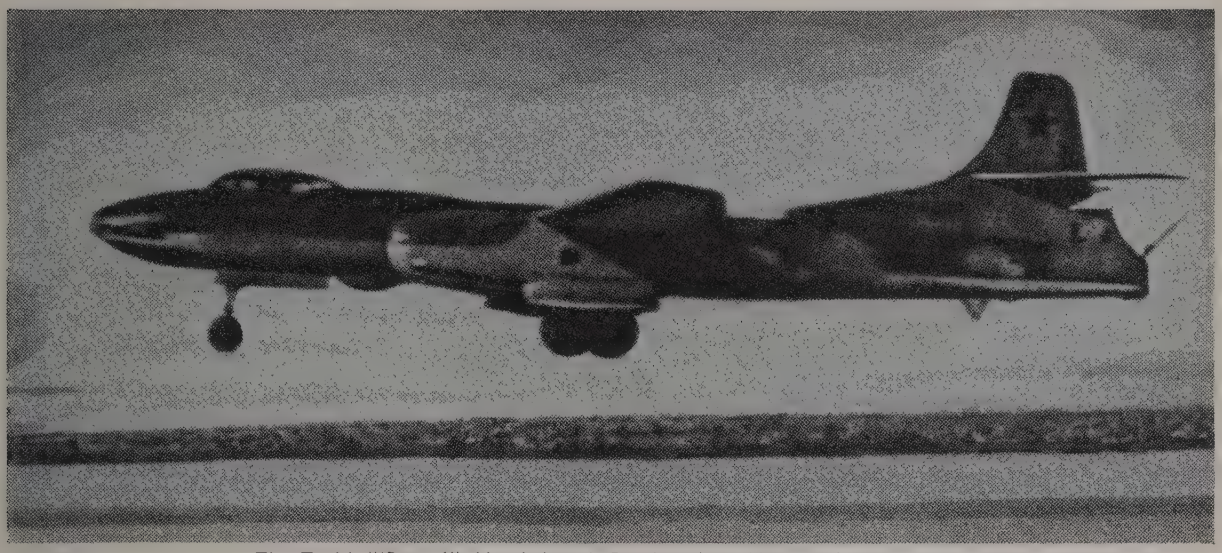
TYPE.—Twin-jet Attack Bomber.

WINGS.—Shoulder-wing all-metal cantilever monoplane.

FUSELAGE.—Circular section all-metal structure.

TAIL UNIT.—Swept-back tailplane. Low aspect-ratio fin and rudder with fin extension.

LANDING GEAR.—Retractable nose-wheel type. Main wheels retract into nacelles.



The Tu-14 ("Bosun") Naval Attack Bomber (two VK-1 turbojet engines).

POWER PLANT.—Two VK-1 turbojet engines (each 2,700 kg. = 5,955 lb. s.t.).
ACCOMMODATION.—Raised cockpit hood. Probably a nose position for bomb-aimer. Tail gunner's position.
ARMAMENT.—Believed two guns under nose. Twin guns in tail. Two torpedoes or bombs in fuselage bomb-bay.
DIMENSIONS (Approx.).—
Span 21.33 m. (70 ft. 0 in.).
Length 19.80 m. (65 ft. 0 in.).
WEIGHT (estimated).—
Weight loaded 20,400 kg. (45,000 lb.).
PERFORMANCE (estimated).—
Max. speed 900 km.h. (560 m.p.h.).
Range 2,900 km. (1,800 miles).

WINICKI

Photographs showing a model of a new light helicopter designed by Winicki were published early in 1958. Few details of this aircraft are available, except that it has a 260 h.p. AI-14 engine ; but it is of conventional pod-and-boom design on the lines of the Sikorsky S-51, with three-bladed main and tail rotors and a tubular skid landing gear.

DIMENSIONS.—
Rotor diameter 11.0 m. (36 ft. 0 in.).
WEIGHTS.—
Weight empty 810 kg. (1,786 lb.).
Weight loaded 1,300 kg. (2,866 lb.).
PERFORMANCE.—
Max. speed 150 km.h. (93 m.p.h.).
Cruising speed 114 km.h. (71 m.p.h.).
Hovering ceiling 1,000 m. (3,280 ft.).
Absolute ceiling (two persons) 4,190 m. (13,750 ft.).
Range 345 km. (215 miles).

YAKOVLEV

ALEKSANDIR SERGIEVICH YAKOVLEV.

Yakovlev is one of the most versatile Russian designers and the current products of his design bureau range from the Yak-25 twin-jet fighter to the Yak-24 tandem-rotor helicopter and a whole series of training and light general-purpose aircraft. All are described hereafter.

THE YAK-25.

NATO Code Name: "Flashlight A."

This twin-jet night and all-weather fighter was seen publicly for the first time at Tushino in July, 1955, and has since been standard equipment in the Soviet Air Force.

The code name for the basic Yak-25 is "Flashlight." Two developments of the Yak-25, first seen at Tushino in 1956, are identified as follows :—

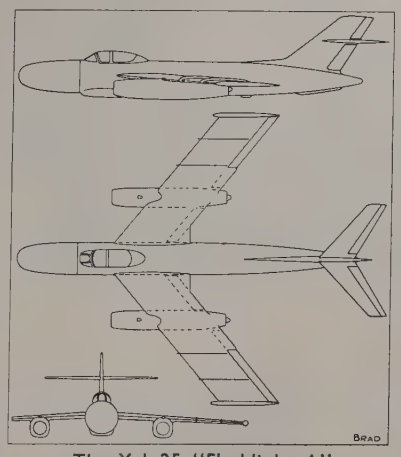
NATO Code Name: "Flashlight B."

This version has a pointed glazed nose presumably to accommodate a bomb-aimer. The cockpit canopy has been redesigned for a single occupant. This version is thought to be a light bomber or pathfinder. No external gun fairings are visible, as on the fighter versions.

NATO Code Name: "Flashlight C."

This model has a revised nose shape, the radome being pointed in contrast with the rounded radome of the original "Flashlight." It has a dorsal spine and its turbojets are fitted with afterburners.

TYPE.—Twin-jet Night/All-weather Fighter.
WINGS.—Mid-wing cantilever monoplane. Anhedral approximately 3°. Leading-edge sweepback 45°. Trailing-edge of centre-section straight. Outer wings are of constant chord. Two fences on each side.
FUSELAGE.—Circular-section all-metal structure.
TAIL UNIT.—All surfaces swept. Tailplane mounted midway up fin. Small ventral keel.
LANDING GEAR.—Tandem, or "bicycle" type with single front wheel just aft of radome and twin rear wheels aft of wing trailing-edge, all retracting aft into fuselage. Small wheels in housings at wing-tips act as stabilisers on ground.
POWER PLANT.—Two small-diameter axial-flow turbojet engines, estimated to be of about 3,630-4,080 kg. (8,000-9,000 lb.) s.t. each.
ACCOMMODATION.—Crew of two in tandem.
ARMAMENT.—Includes two heavy guns in lower forward fuselage and provision for an under-fuselage pack of unguided air-to-air rockets.
DIMENSIONS (estimated).—
Span 12.40 m. (40 ft. 8 in.).
Length 16.65 m. (54 ft. 7½ in.).
PERFORMANCE (estimated).—
Max. speed 1,100 km.h. (683 m.p.h.) at S/L.
WEIGHTS (estimated).—
Weight empty 7,700 kg. (17,000 lb.).
Max. loaded weight 12,250 kg. (27,000 lb.).
Service ceiling 15,250 m. (50,000 ft.).



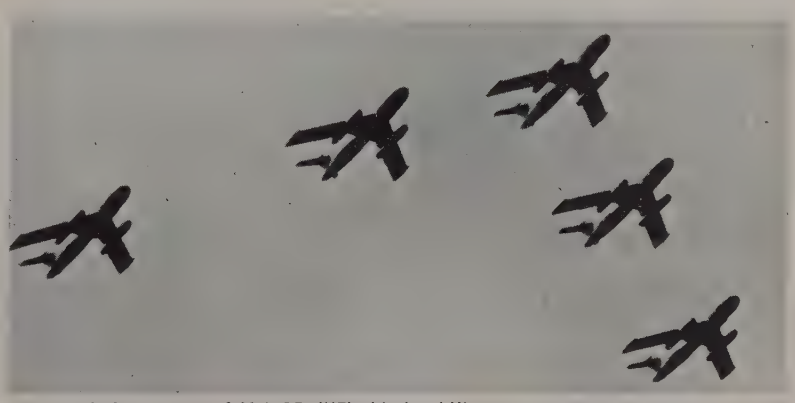
The Yak-25 "Flashlight A"

THE YAK-24 HELICOPTER.

NATO Code Name: "Horse."

The Yak-24 was designed by A. S. Yakovlev and N. K. Skrzhinskii, with ten other co-workers, its development being speeded by the fact that each of its rotors is similar to that of the Mil Mi-4 helicopter. It was first seen at Tushino in 1955.

On December 17, 1955, two international class records were set up by a Yak-24, which lifted a load of 2,000 kg. (4,409 lb.) to a height of 5,082 m. (16,673



A formation of Yak-25 ("Flashlight A") twin-jet Night Fighters.



The Yak-24 Transport Helicopter (two 1,700 h.p. ASh-82V engines).

ft.) and 4,000 kg. (8,818 lb.) to 2,000 m. (6,562 ft.). The latter record has since been beaten.

TYPE.—Tandem-rotor Transport Helicopter.

ROTORS.—Two four-blade rotors rotating in opposite directions. Each is driven by its own engine but rotors are inter-connected by torsion shaft so that rotation continues should one engine fail.

FUSELAGE.—Rectangular-section steel-tube structure in three sections. Front and rear sections are metal-covered, middle section is fabric covered.

TAIL UNIT.—Braced dihedral tailplane on each side of rear rotor pylon, with rectangular fins at tips.

LANDING GEAR.—Four wheels with 5.3 m. (17 ft. 5 in.) track. Oleo shock-absorbers.

POWER PLANT.—Two 1,700 h.p. ASh-82V fourteen-cylinder radial air-cooled engines, either of which is capable of turning both rotors.

ACCOMMODATION.—Forward cabin accommodates crew of 3-4, pilot, co-pilot, navigator/radio operator. A passage alongside front engine, which can be inspected in flight, leads to main hold or cabin. Varying loads may be carried—typical of which are three normal size trucks; two GAZ-69 Jeeps; one GAZ-69 towing twin-barrelled 14.5 mm. A.A. machine-gun, plus crew of 6; or up to 40 persons. The rear section of the fuselage includes a loading ramp for loading wheeled or tracked vehicles, heavy equipment, etc. Cabin length 10 m. (33 ft.).

DIMENSIONS (approx.).—
Rotor diameter 21.0 m. (68 ft. 11 in.).
Length of fuselage 28.0 m. (92 ft. 0 in.).
Height to top of rear rotor head 7.0 m. (23 ft. 0 in.).

WEIGHTS (approx.).—
Useful load 4,000 kg. (8,800 lb.).
Weight loaded 16,000 kg. (35,200 lb.).

PERFORMANCE.—
Cruising speed approx. 177 km.h. (110 m.p.h.).
Service ceiling 5,500 m. (18,000 ft.).
Range 800 km. (497 miles).



The Yak-18U Trainer (160 h.p. M-11 engine).



The Yak-18 Trainer (160 h.p. M-11 engine).

THE YAK-20.

First seen early in 1958, the Yak-20 is a two-seat light aircraft which has been developed from the Yak-18U for DOSAAF, the Russian flying club organisation. In general it is similar in appearance to the Yak-18U, except that its radial engine is enclosed in an NACA-type cowling without the streamlined blisters found on the earlier design.

THE YAK-18.

NATO Code Name: "Max."

Standard primary trainer of the Soviet Air Force and civil flying clubs since 1946, the Yak-18 and its developments are also in service in Austria, China, Czechoslovakia, North Korea and Poland. The following versions have been produced:—

Yak-18. Initial production version.

Yak-18U. Modified version of Yak-18 with tricycle landing gear. Main wheels repositioned to an attachment at the rear spar, and retract forward; nose-wheel retracts to rear. Forward part of fuselage somewhat lengthened. Cylinder head covers of the cowling of the M-11FR-1 engine modified to permit a more extensive frontal air entry.

Yak-18A. Cleaned up development of Yak-18U with more powerful 260 h.p. AI-14R engine. Introduced in 1957.

Yak-18P. Single-seat version of Yak-18A for advanced training, including aerobatics. Fuel system for inverted flying.

The following description refers specifically to the basic Yak-18, but is generally applicable to the other versions except in respect of the landing gear and power plant.

TYPE.—Two-seat Training monoplane.

WINGS.—Low-wing cantilever monoplane. Dihedral 7° 20'. Metal structure, leading-edge stiffened with aluminium sheet, and fabric covering. Large ailerons in outer panels; one-piece flap across centre-section at trailing-edge. Wing area 16.9 m.² (183 sq. ft.).

FUSELAGE.—Steel-tube structure, with built-up formers and longerons. Metal covering back to rear cockpit, fabric covering on rear section.

TAIL UNIT.—Braced monoplane type with single fin and rudder. Fabric covering on all surfaces. Trim tab in rudder.

LANDING GEAR.—Retractable tail-wheel type. Wheels retract pneumatically backwards into wells in wing, about half of wheel remaining exposed. Pneumatic brakes. Fixed castoring tail-wheel.

POWER PLANT.—One 160 h.p. M-11FR five-cylinder air-cooled single-row radial engine in "helmeted" cowl. VISh(a) two-blade variable-pitch metal airscrew. Diameter 2 m. (6 ft. 6½ in.). Special fuel and oil systems for prolonged inverted flight. Fuel in two tanks in wing roots, with total capacity of 130 litres (28.5 Imp. gallons).

ACCOMMODATION.—Two seats in tandem beneath continuous canopy raised above top-line of fuselage. Separate rearward-sliding hoods.
EQUIPMENT.—Includes blind-flying instruments, radio receiver and transmitter.
DIMENSIONS (Yak-18).—
Span 10.30 m. (33 ft. 9½ in.).
Length 8.07 m. (26 ft. 6 in.).
Height 3.1 m. (10 ft. 4 in.).
DIMENSIONS (Yak-18U, A and P).—
Span 10.30 m. (33 ft. 9½ in.).
Length 8.53 m. (28 ft. 0 in.).
Height 3.35 m. (11 ft. 0 in.).
WEIGHTS (Yak-18).—
Weight empty 816 kg. (1,795 lb.).
Weight loaded 1,120 kg. (2,470 lb.).
WEIGHTS (Yak-18U).—
Weight empty 970 kg. (2,138 lb.).
Weight loaded 1,300 kg. (2,866 lb.).
WEIGHTS (Yak-18P).—
Weight empty 907 kg. (2,000 lb.).
Weight loaded 1,050 kg. (2,315 lb.).
PERFORMANCE (Yak-18).—
Max. speed 248 km.h. (153 m.p.h.).
Cruising speed 215 km.h. (133.5 m.p.h.).
Landing speed 85 km.h. (53 m.p.h.).
Climb to 1,000 m. (3,280 ft.) 5 min.
Service ceiling 4,000 m. (13,120 ft.).
Max. range 1,000 km. (620 miles).
Take-off run 290 m. (316 yds.).
Landing run 247 m. (270 yds.).
PERFORMANCE (Yak-18U).—
Max. speed 235 km.h. (146 m.p.h.).
Landing speed 103 km.h. (64 m.p.h.).
Climb to 1,000 m. (3,280 ft.) 5 min. 12 sec.
Range 900 km. (560 miles).



The Yak-12M General Purpose Monoplane (240 h.p. AI-14R engine).

ditions two men can modify the passenger version into an ambulance or freight version in 25-30 minutes or to the agricultural version in 2½-3 hours.

Yak-12A. First reported in September 1957, this version has a greater payload and improved range. The wing planform has been modified, with tapered outer panels. Other changes are mainly internal, including additional fuel tankage.



The Yak-11 Advanced Trainer (730 h.p. ASh-21 engine).

PERFORMANCE (Yak-18A).—
Max. speed 260 km.h. (161 m.p.h.).
Range 750 km. (465 miles).
PERFORMANCE (Yak-18P).—
Max. speed 300 km.h. (186 m.p.h.).
Rate of climb at S/L 540 m./min. (1,770 ft./min.).
Take-off run 95 m. (312 ft.).
Landing run 170 m. (560 ft.).
Max. range 1,500 km. (930 miles).

THE YAK-12.
NATO Code Name: "Creek."

The original Yak-12 prototype appeared in 1944. Production models ("Creek-A"), of mixed wood and metal construction and powered by the 145 h.p. M-11D or M-11FR engine, began to replace the Po-2 for certain duties in 1949.

Since then the design has undergone continuous development, and the main current versions are as follows :—

Yak-12R ("Creek-C"). Development of Yak-12 powered by a 240 h.p. AI-14R nine-cylinder radial engine. Prototype first flew in 1952 and since then the Yak-12R and its developments have been supplied steadily to the Soviet Air Force and various aviation institutions. Basically a general purpose four-seat aircraft. One specific use is that of glider-tug.

Yak-12M ("Creek-B"). Improvement of Yak-12R, with all-metal structure, introduced in late 1955 or early in 1956. Power plant is the same and in general the appearance is little altered except for the addition of a fin extension along top of fuselage, which is lengthened by 0.60 m. (2 ft.). This version provided in passenger, ambulance, freight and agricultural versions. Under field con-

The following data apply specifically to the Yak-12M.

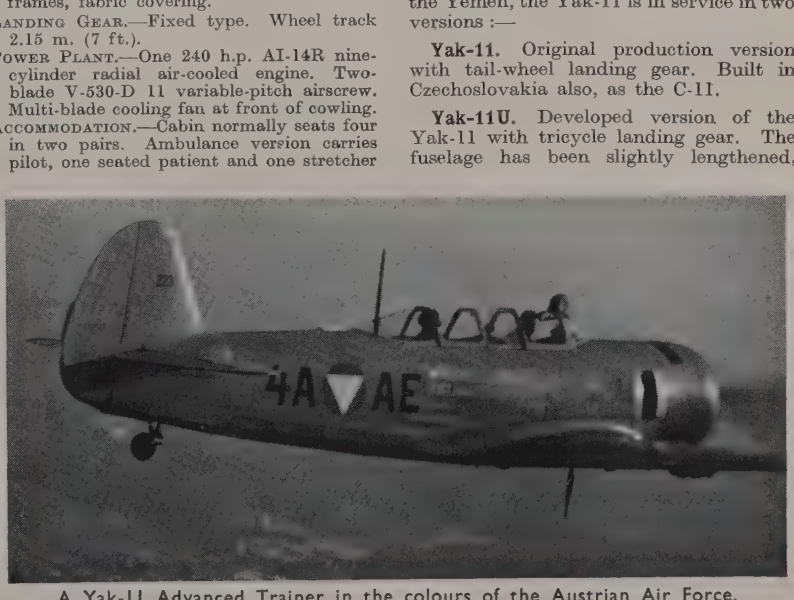
TYPE. — Single-engined General Purpose monoplane.
WINGS.—High-wing rigidly-braced monoplane. All-metal two-spar structure. Vee bracing struts. Slotted ailerons and slotted flaps. Leading-edge slats. Wing area 23.86 m.² (256.8 sq. ft.).
FUSELAGE.—Rectangular welded steel-tube structure covered with metal and fabric.
TAIL UNIT.—Braced monoplane type. Metal frames, fabric covering.
LANDING GEAR.—Fixed type. Wheel track 2.15 m. (7 ft.).
POWER PLANT.—One 240 h.p. AI-14R nine-cylinder radial air-cooled engine. Two-blade V-530-D 11 variable-pitch airscrew. Multi-blade cooling fan at front of cowling.
ACCOMMODATION.—Cabin normally seats four in two pairs. Ambulance version carries pilot, one seated patient and one stretcher case and a medical attendant. Large triangular loading hatch on port side at rear of cabin for loading stretcher or freight. The freight version has attachment lugs for securing loads up to 300 kg. (660 lb.). The agricultural version has a special container of 470 litres capacity for chemicals and apparatus for spraying, etc.
DIMENSIONS.—
Span 12.60 m. (41 ft. 4 in.).
Length 9.0 m. (29 ft. 6 in.).
Height 3.12 m. (10 ft. 3 in.).
WEIGHT (Yak-12R).—
Weight loaded 1,285 kg. (2,833 lb.).
WEIGHTS (Yak-12M).—
Weight empty 1,026 kg. (2,262 lb.).
Weight loaded (1,450 kg. (3,197 lb.).
WEIGHTS (Yak-12A).—
Weight empty 1,059 kg. (2,330 lb.).
Weight loaded 1,588 kg. (3,494 lb.).
PERFORMANCE (Yak-12R).—
Max. speed 184 km.h. (114 m.p.h.).
Range 500 km. (310 miles).
T.O. run 75 m. (246 ft.).
Landing run 65 m. (213 ft.).
PERFORMANCE (Yak-12M).—
Max. speed 180 km.h. (112 m.p.h.).
Cruising speed 127 km.h. (79 m.p.h.).
Landing speed 73 km.h. (45.4 m.p.h.).
Rate of climb at S/L 245 m./min. (805 ft./min.).
Ceiling 4,160 m. (13,650 ft.).
Range 450 km. (280 miles).
PERFORMANCE (Yak-12A).—
Max. speed 215 km.h. (133.5 m.p.h.).
Cruising speed 155 km.h. (96 m.p.h.).
Landing speed 90 km.h. (56 m.p.h.).
Landing run 131 m. (430 ft.).
Range 1,070 km. (688 miles).

THE YAK-11.
NATO Code Name: "Moose."

Standard two-seat intermediate trainer in the air forces of Russia, Afghanistan, Albania, Austria, Bulgaria, China, Egypt, Hungary, Poland, Rumania, Syria and the Yemen, the Yak-11 is in service in two versions :—

Yak-11. Original production version with tail-wheel landing gear. Built in Czechoslovakia also, as the C-11.

Yak-11U. Developed version of the Yak-11 with tricycle landing gear. The fuselage has been slightly lengthened,



A Yak-11 Advanced Trainer in the colours of the Austrian Air Force.

and the main wheels repositioned. Built in Czechoslovakia as the C-11U.

The following details apply specifically to the Yak-11, but are generally applicable to the Yak-11U also.

TYPE.—Two-seat intermediate and advanced trainer.

WINGS.—Low-wing cantilever monoplane. Modified Clark YA section. All-metal structure. Dihedral from roots. Fabric-covered metal ailerons and split flaps. Wing area 15.40 m.² (166 sq. ft.).

FUSELAGE.—Steel-tube structure. Rear portion fabric-covered.

TAIL UNIT.—Cantilever monoplane type with single fin and rudder. Inset elevators, with trim-tabs. All-metal structure, with fabric covering on rudder and elevators.

LANDING GEAR.—Retractable tail-wheel type. Main legs and wheels retract inwards to lie flush in wing beneath fuselage. Non-retractable steerable tail-wheel. Wheel track 3.435 m. (11 ft. 3½ in.).

POWER PLANT.—One ASh-21 seven-cylinder air-cooled radial engine. Take-off power 730 b.h.p. at 2,300 r.p.m. at sea level. Maximum continuous cruising rating 680 b.h.p. at 1,900 r.p.m. VISh-11 V-20 two-blade metal controllable-pitch airscrew. Fuel capacity 360 litres (79 Imp. gallons). Oil capacity 37.5 litres (8.25 Imp. gallons).

ACCOMMODATION.—Two seats in tandem beneath long "glass-house" enclosure raised above top line of fuselage. Separate rearward-sliding canopies.

ARMAMENT.—A single 7.7 mm. machine-gun is installed on top port side of engine cowling for gunnery training. Racks for practice bombs can be fitted under wings.

EQUIPMENT.—Includes full RSIU-3M radio receiver and transmitter sets. A camera can be mounted forward of canopy on windscreen framework.

DIMENSIONS (Yak-11).—
Span 9.40 m. (30 ft. 10 in.).
Length 8.50 m. (27 ft. 10¾ in.).
Height 3.283 m. (10 ft. 9¼ in.).

WEIGHTS (Yak-11).—
Weight empty 2,000 kg. (4,410 lb.).
Weight loaded 2,500 kg. (5,512 lb.).

WEIGHTS (Yak-11U).—
Weight empty 2,066 kg. (4,555 lb.).
Weight loaded 2,500 kg. (5,512 lb.).

PERFORMANCE (Yak-11).—
Max. speed at S/L 424 km.h. (263 m.p.h.).
Max. speed at 2,250 m. (7,380 ft.) 460 km.h. (286 m.p.h.).
Landing speed 127 km.h. (79 m.p.h.).
Service ceiling 7,100 m. (23,300 ft.).
Take-off run 500 m. (1,640 ft.).
Landing run 1,040 m. (3,410 ft.).
Max. range 1,280 km. (795 miles).

MISCELLANEOUS UNIDENTIFIED AIRCRAFT.

Hereafter are listed five Russian military aircraft concerning which insufficient information is available to enable them to be positively identified.

1. Probably under development as a replacement for the Tu-16, an advanced sweptwing bomber has been flying in prototype form since 1957. Code-named "Backfin," it has two turbojets of very high power mounted inside its fuselage, with shoulder intakes above and forward of the mid-wing. Its estimated span is 24 m. (78 ft.), with a length of 31 m. (102 ft.) and speed of Mach 1.5.

2. This unidentified fighter, code-named "Fitter," which was exhibited briefly at Tushino in 1956, resembles fairly closely the MiG-19 and "Faceplate." However, its fuselage is almost identical with that of "Fishbed" which may identify it as a Sukhoi design.

Noteworthy points are the centre-body intake to the large axial-flow turbojet, and the broad-chord wing-roots.

The span is thought to be about 11.5 m. (37 ft. 9 in.), and the length 12.75 m. (41 ft. 10 in.).



The unidentified Fighter code-named "Fitter."

3. This bomber, code-named "Blowlamp," was shown to Western aeronautical representatives at Kubinka in June, 1956, and is reported to be an Ilyushin design, with the design bureau designation of Il-140. Its sharply-swept wing is mounted near the top of the fuselage, with two turbojets slung in "pods" underneath, rather in the manner of the Douglas B-66. The tail surfaces are also swept. The engines are said to be MR-40 turbojets, each developing 5,000 kg. (11,000 lb.) s.t. dry and 7,800 kg. (17,200 lb.) s.t. with afterburning.

The glazed nose portion holds a crew of three; there is a two-gun tail turret but full armament details are not available. A tandem undercarriage is fitted with outrigger wheels that retract into wing-tip fairings.

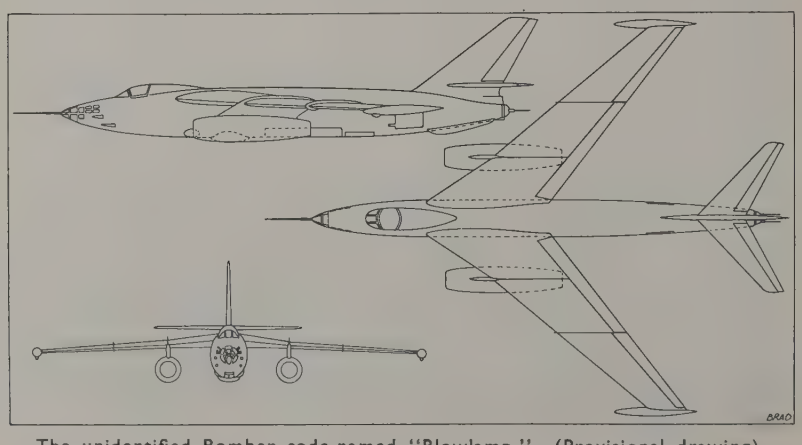
The following data are believed reliable:

DIMENSIONS.—
Span 20 m. (65 ft. 7 in.).
Length 23 m. (75 ft. 5 in.).
Height 4.9 m. (16 ft. 0 in.).
Wing area 79.5 m.² (856 sq. ft.).

WEIGHTS.—
Weight empty 13,600 kg. (30,000 lb.).
Weight loaded 22,700 kg. (50,000 lb.).

PERFORMANCE.—
Max. speed Mach 1.3.
Take-off run with afterburning 900 m. (3,000 ft.).
Range 1,600 km. (1,000 miles).

4. Among other Soviet military aeroplanes shown to Western aeronautical representatives at Kubinka in June, 1956 was a twin-jet ground attack monoplane with ventral armour plating. Code-named "Brawny," it has been described as a conventional straight-wing design, with swept tail surfaces and tandem seats under a continuous cockpit "glass-house." Armament includes fixed guns in the nose and a remotely-controlled tail-turret. Bombs and rockets are carried on underwing racks. It is doubtful if this aircraft has entered service with the Soviet Air Force.



The unidentified Bomber code-named "Blowlamp." (Provisional drawing).

5. Another Kubinka revelation was a single-engined naval attack aeroplane, which has been code-named "Boot." It is described as a low-wing monoplane of conventional straight-wing design, powered by a single turboprop engine (possibly 4,000 h.p. Kuznetsov), driving contra-rotating airscrews. The crew sit in tandem under a continuous canopy, and there is also an observation position with windows in the nose, under the engine.

The version shown at Kubinka carried three small torpedoes externally, and "Boot" is almost certainly the Soviet Navy's counterpart of the British Fairey Gannet.

6. A number of flapping-wing ornithopters have been built by Soviet designers in recent years and some are claimed to have flown successfully. That designed by Pavel Smirnov is stated to have bird-like wings; while Herman Rybnikov's ornithopter has wings resembling those of an insect. When fitted with a 145 h.p. M-11 engine, these aircraft are claimed to have been capable of lifting 15 persons.

SPAIN

AERO DIFUSIÓN

AERO-DIFUSIÓN S.L.

HEAD OFFICE AND WORKS: AERODROMÓ DE LA ALBERÍCIA, SANTANDER.

President: Adolfo F. L. Merino.

Technical Director: P. F. Fernández.

Chief Aeronautical Engineer: E. C. Alviñana.

General Manager: E. L. Merino.

After first building experimentally a French-designed Jodel D.112 lightplane in 1954, this company was registered on May 6, 1955, to manufacture, overhaul and repair aircraft.

It is now building under licence the dual-control two-seat Jodel D.112, the single-seat Jodel D.9 and the single-seat Druine Turbulent, all of which are described in the French section of this work. A D.112 built by Aero-Difusión was the first aircraft of Spanish construction to be exported to a foreign country.



The Spanish-built Jodel D.112 (65 h.p. Continental A65 engine).

AEROTECNICA

AEROTECNICA S.A.

HEAD OFFICE: VELÁZQUEZ, 38, MADRID.

Aerotecnica S.A. has formed a helicopter department which it has placed under the technical direction of the French engineer Jean Cantinieau.

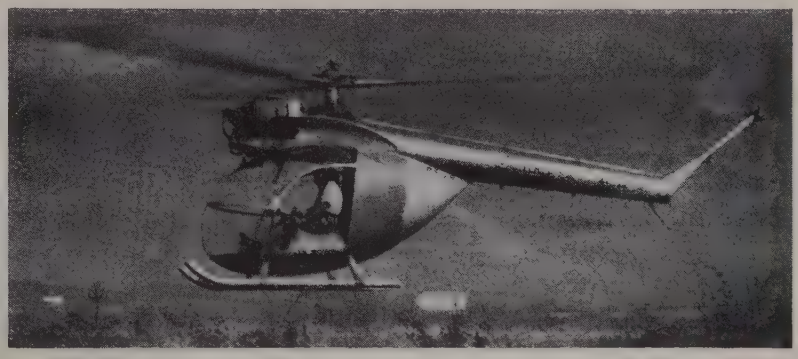
Aerotecnica began by engaging the services of M. Cantinieau and at the same time acquiring the Matra-Cantinieau MC-101 light helicopter which was built by the French Société Matra in 1952. This helicopter was given the designation AC-11 (Aerotecnica-Cantinieau-11).

From the AC-11 have been developed the AC-12 and AC-13, the former powered by a 150 h.p. Lycoming O-320 engine and the latter by a Turbomeca Artouste I gas turbine.

Two prototypes of the AC-12 were built in Madrid by the A.I.S.A. company and ENHASA, the national airscrew company. A production order for 12 more has been received from the Spanish Government. Two prototypes of the AC-13 were built in France by the Société Nationale de Constructions Aéronautiques du Nord (S.N.C.A.N.), which had acquired a licence to build the AC-13 and by whom it was known as the Nord 1750 Norelfe. This licence has now lapsed and the two prototypes have been acquired by the Spanish Government

An improved version of the AC-13, known as the AC-14, has now been designed and the first of six AC-14's on order is being completed in Madrid by ENHASA. In addition, Aerotecnica is working on the design of the AC-15 helicopter, powered by a 245-260 h.p. Lycoming O-435-V engine.

A further development is the AC-21, a projected 10-12 passenger helicopter powered by two Turbomeca Turmo III turbines.



The Aerotecnica AC-12 Helicopter (150 h.p. Lycoming O-320 engine).

THE AEROTECNICA AC-12.

Like the original Matra-Cantinieau MC-101, the AC-12 has its engine mounted above the cabin. Two prototypes are being built by the A.I.S.A. company, with a transmission and reduction gear designed on motor-car principles and built by the ENHASA airscrew company. The Spanish Government has ordered twelve of these aircraft.

TYPE.—Two-seat Single-rotor Helicopter.

ROTOR.—Three-blade rotor with double-articulated blades. Each blade has a solid machined duralumin spar which forms the leading-edge, duralumin ribs and trailing-edge. Space between ribs is filled with a plastic foamed resin compound named Klegecell, with a final overall covering of Fiberglas. Floating hub, with cyclic and collective-pitch changes made through a "spider." Rotor blade area 0.9405 m.² (10.1 sq. ft.). Rotor disc area 57 m.² (613.3 sq. ft.). Three-blade anti-torque rotor of similar construction to main rotor. Anti-torque rotor blade area 0.0927 m.² (1.0 sq. ft.). Anti-torque rotor disc area 2.26 m.² (24.3 sq. ft.).

ROTOR DRIVE.—The main rotor is driven direct from the engine gear-box (7.28 : 1 ratio) and clutch through a universal joint. The anti-torque rotor is driven through a gear-box (1.43 : 1 ratio) and cardan shaft.

FUSELAGE.—Light alloy structure.

LANDING GEAR.—Skid type. Track of skids 2.0 m. (6 ft. 6 in.).

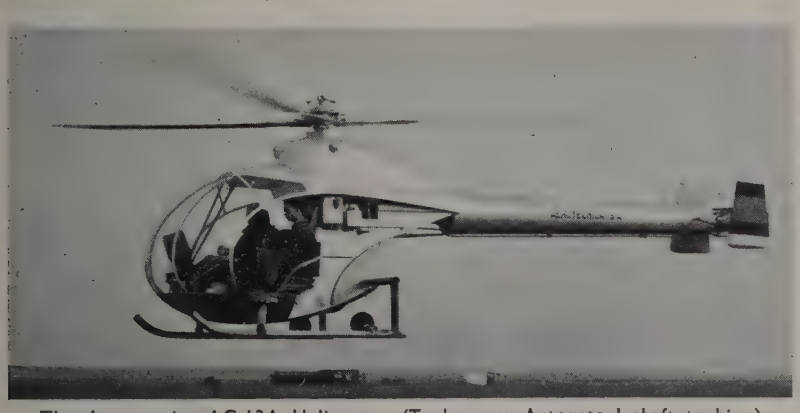
POWER PLANT.—One 150 h.p. Lycoming O-320 fan-cooled engine mounted above the cabin with direct drive through the gear-box to the main rotor. Fuel tank behind cabin. Fuel capacity 90 litres (20 Imp. gallons).

ACCOMMODATION.—Enclosed cabin seating two side-by-side with dual controls. Entrance door on each side of cabin.

DIMENSIONS.—
- Main rotor diameter 8.50 m. (27 ft. 10 in.).
- Overall length 8.30 m. (27 ft. 9 in.).
- Length of fuselage 7.35 m. (24 ft. 1 in.).
- Overall height (to top of rotor pylon) 2.75 m. (9 ft.).
- Width of fuselage 1.22 m. (4 ft.).
- Diameter of anti-torque rotor 1.70 m. (5 ft. 6 in.).

WEIGHTS.—
- Weight empty 480 kg. (1,056 lb.).
- Disposable load 240 kg. (528 lb.).
- Weight loaded 720 kg. (1,584 lb.).

PERFORMANCE.—
- Max. speed at S/L. 121 km.h. (75 m.p.h.).
- Cruising speed 102 km.h. (63 m.p.h.).
- Hovering ceiling with ground effect 1,770 m. (5,800 ft.).
- Best rate of climb at S/L. 258 m./min. (846 ft./min.).
- Service ceiling 3,100 m. (10,200 ft.).
- Still air cruising range 216-324 km. (135-200 miles).



The Aerotecnica AC-13A Helicopter (Turbomeca Artouste I shaft turbine).

THE AEROTECNICA AC-13A.

The three-seat AC-13A is similar in general arrangement to the AC-12 but is fitted with a Turbomeca Artouste I shaft turbine power-unit which is mounted behind the cabin and drives the main rotor through clutch and gear-box. The residual thrust of some 60 kg. (132 lb.) is ducted through the tubular rear fuselage and is used for torque compensation and directional control. For the latter the rear end of the jet duct is provided with an articulated extension with apertures to the right and left. Movement of this section is by pedal control and the same control linkage moves two small vertical fins, which provide added control in cruising flight and during autorotation.

It is planned to arrange the tail nozzle so that at high cruising speeds all residual thrust can be vented rearward to provide

forward thrust, only the fins being used for directional control.

Two prototypes of the AC-13A were built by S.N.C.A.N. (France), who then held the licence rights and the first of these flew in July, 1954. Known as the Nord 1750 Norelfe, these prototypes have now been acquired by the Spanish Government.

TYPE.—Three-seat Single-rotor Helicopter.

ROTOR.—Three blade rotor with double-articulated blades of similar construction to those of AC-12. Rotor blade area each 0.99 m.² (10.66 sq. ft.). Rotor disc area 64 m.² (689 sq. ft.). Anti-torque control by jet-deflection.

ROTOR DRIVE.—The main rotor is driven directly from the turbine gear-box (16.7 : 1 ratio) and clutch through a universal joint.

FUSELAGE.—Light alloy structure.

LANDING GEAR.—Skid type. Track of skids 2.0 m. (6 ft. 6 in.).

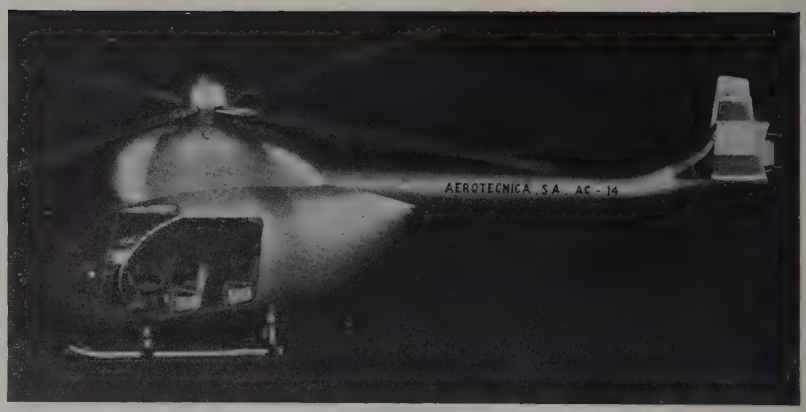
POWER PLANT.—One 260 h.p. Turbomeca Artouste I shaft turbine. In practice, only 170 h.p. are taken by the transmission, of which 146 h.p. are applied to the rotor and 24 h.p. absorbed by the reduction gearing. The remaining 90 h.p. (equivalent to 60 kg. = 132 lb. s.t.) are used for anti-torque control. Total fuel capacity 115 litres (25 Imp. gallons). Oil capacity 20 litres (4.4 Imp. gallons).

ACCOMMODATION.—Enclosed cabin seating pilot in front and two passengers side-by-side behind. Entrance door on each side of cabin.

DIMENSIONS.—
Main rotor diameter 9.04 m. (30 ft. 9 in.).
Overall length 7.80 m. (25 ft. 7 in.).
Length of fuselage 7.50 m. (24 ft. 7 in.).
Height (to top of rotor pylon) 2.75 m. (9 ft.).

WEIGHTS.—
Weight empty 575 kg. (1,265 lb.).
Weight loaded 880 kg. (1,940 lb.).

PERFORMANCE.—
Max. speed at S/L. 140 km.h. (87 m.p.h.).
Cruising speed 124 km.h. (77 m.p.h.).
Hovering ceiling with ground effect 2,650 m. (8,700 ft.).
Best rate-of-climb at S/L. 276 m./min. (905 ft./min.).
Service ceiling 6,065 m. (19,900 ft.).
Still air cruising range 140-345 km. (87-215 miles).



A model of the Aerotecnica AC-14 Five-seat Helicopter.

THE AEROTECNICA AC-14.

The AC-14 is an enlarged version of the AC-13, powered by a Turbomeca Artouste II shaft turbine and with accommodation for five persons. As in the AC-12, the engine is mounted above the cabin, which is extensively sound-proofed. Residual thrust is used to increase forward speed, leaving the movable tail fins to provide anti-torque and directional control.

Six AC-14's are being built by the ENHASA company.

TYPE.—Five-seat Single-rotor Helicopter.

ROTOR.—Four-blade rotor with double-articulated blades of similar construction to those of AC-12. Rotor blade area each 1.056 m.² (11.37 sq. ft.). Rotor disc area 72.35 m.² (778.78 sq. ft.). Anti-torque control by gas deflection in helicopter flight and by vertical rudders in gyrodyne flight (high speed cruising).

ROTOR DRIVE.—The main rotor is driven directly from the turbine gear-box (17.75 : 1 ratio) through a universal joint.

FUSELAGE.—Light alloy structure.

LANDING GEAR.—Skid type. Track of skids 2.0 m. (6 ft. 6 in.).

POWER PLANT.—One Turbomeca Artouste II shaft-turbine, developing 320 h.p. and 80 kg. (176 lb.) residual thrust. During vertical climb, 250 h.p. are taken by the main transmission, of which 213 h.p. are applied to the rotor. Maximum continuous power is 220 h.p. in the transmission and 187 h.p. at the rotor.

ACCOMMODATION.—Enclosed cabin seating pilot at the front and four passengers in two side-by-side pairs behind. Entrance door on each side of cabin.

DIMENSIONS.—
Main rotor diameter 9.60 m. (31 ft. 6 in.).
Overall length 11.22 m. (36 ft. 9 in.).
Length of fuselage 8.25 m. (27 ft. 1 in.).
Height (to top of rotor pylon) 3.10 m. (10 ft. 2 in.).

WEIGHTS.—
Weight empty 625 kg. (1,378 lb.).
Weight loaded 1,200 kg. (2,646 lb.).

PERFORMANCE (estimated).—
Max. speed (max. cont. power) at S/L. 160 km.h. (99 m.p.h.).
Cruising speed 120 km.h. (75 m.p.h.).
Best rate of climb at S/L. 277 m./min. (910 ft./min.).
Service ceiling 6,350 m. (20,830 ft.).

AISA

AERONAUTICA INDUSTRIAL S.A.

HEAD OFFICE : PLAZA DE LAS CORTES 2, MADRID.

WORKS AND AERODROME : CARABANCHEL ALTO, MADRID

President : Sr. Conde de Mieres.
Chairman : D. Lázaro Ros España.

This concern, with fully-equipped works and adjoining aerodrome at Carabanchel Alto (Madrid), has since 1923 been engaged in the manufacture, reconstruction and repair of aircraft of wood and mixed construction.

In 1946 AISA collaborated with Iberavia S.A. in the construction of various types of aircraft designed by that company, including the I-11 and I-115.

The Aircraft Department of Iberavia S.A. has now been taken over by Aeronautica Industrial S.A., which is continuing the production of the I-115. It has also completed the I-11B, a developed version of the I-11 with a tail-wheel landing-gear. The prototype flew for the first time on October 16, 1953, and the aircraft is now going into series production for the use of aero clubs and for private pilots.

The latest product of Aeronautica Industrial S.A. is the AVD-12 three-seat liaison monoplane, the company's first all-metal aircraft. It was designed by the well-known French aircraft engineer Emile Dewoitine.

AISA is also building the AC-12 helicopter on behalf of Aerotecnica S.A.

THE AISA AVD-12.

The AVD-12 was designed to meet the requirements of a Spanish government specification issued in 1953. Two prototypes have been built :—

AVD-12. First prototype. 150 h.p. ENMA Tigre G-IV-B engine. First flew on August 18, 1955.



The AISA AVD-12 (150 h.p. ENMA Tigre G-IV-B engine).

AVD-12C. Second prototype. 225 h.p. Continental O-470-A engine.

TYPE.—Four-seat general purpose cabin monoplane.

WING.—High-wing cantilever monoplane. Thickness-chord ratio gradually reduced from 18% inboard to 9% at tip. All-metal single-spar structure with torsion box leading-edge. Double trailing-edge surfaces in the form of full-span slotted ailerons in eight sections mounted on a full-span slotted flap. Hydraulic interconnection changes tailplane incidence when flaps are lowered. Flaps are all-metal. Ailerons have metal structure with fabric-covering aft of metal leading-edge. Range of movement of flaps 40°. Range of movement of ailerons 20-25° in all flap positions. Total area of ailerons 2.130 m.² (22.9 sq. ft.). Total area of flaps 2.40 m.² (25.8 sq. ft.). Gross wing area 18 m.² (193.6 sq. ft.).

FUSELAGE.—Elleptical-section all-metal semi-monocoque structure

TAIL UNIT.—Cantilever monoplane type. Single-spar all-metal variable incidence tailplane, adjustable by pilot and linked hydraulically to wing flaps. Single-spar all-metal fin. All-metal elevators. Fabric-covered rudder.

LANDING GEAR.—Fixed tail-wheel type. All three units have Dewoitine type oleo-pneumatic shock-absorbers, those for the main wheels being mounted transversely under the cabin floor. Hydraulic brakes can be operated differentially for steering. Castoring tail-wheel with pilot-applied lock.

POWER PLANT (AVD-12).—One 150 h.p. ENMA Tigre G-IV-B four-cylinder in-line inverted air-cooled engine on a welded steel tube mounting. ENH-P.8 two-blade fixed-pitch metal airscrew.

POWER PLANT (AVD-12C).—One 225 h.p. Continental O-470-A six-cylinder horizontally-opposed air-cooled engine on welded steel tube mounting. McCauley Met-L-Matic two-blade variable-pitch airscrew. Ejector-type engine cooling. Fuel in wing tanks with total capacity of 160 litres (35 Imp. gallons).

Accommodation (AVD-12).—Cabin seats two side-by-side with dual controls, with seat for one or two persons behind. Luggage compartment. Four car-type doors. Windscreens, rear hood, roof and side windows of plexiglas. Stretcher can be loaded through rear starboard door for ambulance duties. Equipment can include mailbag-snatching gear, towing fittings and agricultural equipment.

Accommodation (AVD-12C).—Cabin seats four in two pairs. Dual controls. Remainder as for AVD-12.

Dimensions —
Span 11.1 m. (36 ft. 5 in.).
Length 7.75 m. (25 ft. 5 in.).
Height 2.10 m. (6 ft. 10½ in.).

Weights and Loading (AVD-12).—
Weight empty 715 kg. (1,576 lb.).
Normal loaded weight 1,050 kg. (2,310 lb.).
Max. permissible loaded weight 1,100 kg. (2,425 lb.).
Wing loading 58.33 kg./m.² (11.95 lb./sq. ft.).

Weights and Loading (AVD-12C).—
Weight empty 755 kg. (1,664 lb.).
Normal loaded weight 1,230 kg. (2,712 lb.).
Max. loaded weight 1,300 kg. (2,866 lb.).
Wing loading 72.22 kg./m.² (14.8 lb./sq. ft.).

Performance (AVD-12).—
Max. speed 225 km.h. (140 m.p.h.).



The AISA AVD-12C (225 h.p. Continental O-470-A engine).

wheel brakes. Tail-wheel is linked to rudder-bar but may be disconnected at will by pilot.

Power Plant.—One 150 h.p. ENMA Tigre G-IV-B four-cylinder in-line inverted air-cooled engine. ENHASA P8 two-blade metal airscrew with pitch adjustable on ground. Two fuel tanks in wings. Total fuel capacity 135 litres (30 Imp. gallons).

compartment behind rear seat accessible from outside.

Dimensions.—
Span 9.54 m. (31 ft. 3 in.).
Length 7.35 m. (24 ft. 1 in.).
Height 2.10 m. (6 ft. 10 in.).

Weights and Loadings (Two-seater).—
Weight empty 612 kg. (1,346 lb.).
Weight loaded 900 kg. (1,980 lb.).
Wing loading 64.3 kg./m.² (13.18 lb./sq. ft.).
Power loading 5.06 kg./h.p. (11.13 lb./h.p.).

Performance (two-seater, fully loaded).—
Max. speed 240 km.h. (149 m.p.h.).
Cruising speed 204 km.h. (126.6 m.p.h.).
Landing speed with flaps 81.5 km.h. (50.6 m.p.h.).
Initial rate of climb 225 m./min. (686 ft./min.).
Service ceiling 4,400 m. (14,430 ft.).
Take-off distance to 15 m. (50 ft.) 380 m. (415 yds.).
Landing distance from 15 m. (50 ft.) 350 m. (382 yds.).
Duration (70% power) 5 hours.



The AISA I-115 Two-seat Trainer (150 h.p. ENMA Tigre G-IV-B engine).

Cruising speed (75% power) 195 km.h. (121 m.p.h.).
Min. speed 65 km.h. (40.5 m.p.h.).
Initial rate of climb (at normal A.U.W.) 258 m./min. (850 ft./min.).
Time to 1,000 m. (3,280 ft.) 4 min. 18 sec.
Time to 3,000 m. (9,850 ft.) 17 min. 19 sec.
Time to 5,000 m. (16,400 ft.) 42 min. 3 sec.
Service ceiling 5,400 m. (17,700 ft.).
Max. range 950 km. (560 miles).
Max. endurance 4.5 hours.

Performance (AVD-12C).—
Max. speed 278 km.h. (173 m.p.h.).
Cruising speed (75% power) 267 km.h. (166 m.p.h.).
Min. speed 70 km.h. (43.5 m.p.h.).
Initial rate of climb (at normal A.U.W.) 360 m./min. (1,180 ft./min.).
Time to 1,000 m. (3,280 ft.) 3 min.
Time to 3,000 m. (9,850 ft.) 11 min.
Time to 5,000 m. (16,400 ft.) 26 min. 10 sec.
Service ceiling 6,400 m. (21,000 ft.).
Max. range 1,000 km. (621 miles).
Max. endurance 4 hr. 10 min.

THE AISA I-115.

The first prototype I-115 flew for the first time on June 20, 1952. Under the military designation E.9, this aircraft is being built in series for the Spanish Air Force.

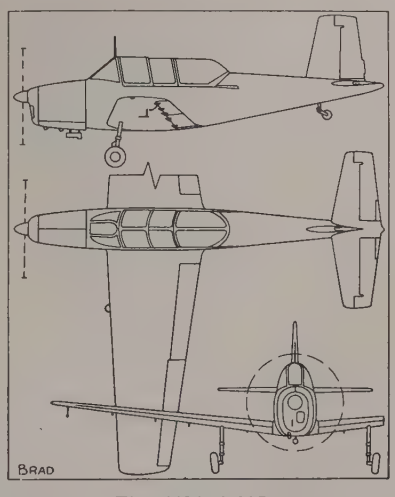
Type.—Two-seat Primary or single-seat Aerobatic Trainer.

Wings.—Low-wing cantilever monoplane. NACA 23015/23009 wing section. Chord 1.96 m. (6 ft. 5 in.) at root, 0.98 m. (3 ft. 2 in.) at tip. Dihedral 6°. Incidence 3°. Single-piece two-spar all-wood structure with stressed plywood skin. Slotted flaps and differentially-operated ailerons have plywood frames and leading-edges and overall fabric covering. Ailerons droop when flaps lowered. Total area of flaps 1.59 m.² (17.1 sq. ft.). Total area of ailerons 1.19 m.² (12.8 sq. ft.). Gross wing area 14.0 m.² (150.6 sq. ft.).

Fuselage.—All-wood monocoque structure.

Tail Unit.—Cantilever monoplane type. Structure and tab arrangements as for I-11. Areas: fin 0.65 m.² (6.9 sq. ft.), rudder 0.55 m.² (5.9 sq. ft.), tailplane 1.56 m.² (16.7 sq. ft.), elevators 1.02 m.² (10.9 sq. ft.). Span of tailplane 3.2 m. (10 ft. 6 in.).

Landing Gear.—Fixed tail-wheel type. Oil/spring shock-absorbers. Hydraulic



The AISA I-115.

Accommodation.—Tandem cockpits under continuous canopy with sliding section over each cockpit. Complete dual controls and instrumentation. Equipment includes Iberavia ITR 6 radio transmitter/receiver and Marconi artificial horizon. Small baggage

THE AISA I-11B.

The prototype I-11 had a tricycle landing-gear and first flew in 1950. The I-11B, with tail-wheel landing-gear, was developed in response to the request of would-be owners for a traditional layout, and the prototype of this version flew on October 16, 1953. The first 70 production I-11B's have only basic flying instruments; the second series of 110 aircraft have a full blind-flying panel.

Type.—Two-seat touring or training monoplane. Fully-aerobatic when flown as a single-seater.

Wings.—Low-wing cantilever monoplane. NACA 23015/23009 wing section. Root chord 1.74 m. (5 ft. 8 in.), tip chord 1.14 m. (3 ft. 9 in.). Dihedral 7°. Incidence 3°. Two-spar wood structure with plywood skin. Differentially-operated ailerons have wood frames and leading-edge and overall fabric covering. Two-position flaps between ailerons and fuselage. Total flap area 1.4 m.² (15 sq. ft.). Total aileron area 1.116 m.² (11.6 sq. ft.). Gross wing area 13.4 m.² (144 sq. ft.).

Fuselage.—All-wood monocoque structure.

Tail Unit.—Cantilever monoplane type. Fixed surfaces have two spars and plywood skin. Movable surfaces have wood frames and leading-edges with a fabric covering. Single-piece elevator has semi-automatic trim-tabs. Rudder tab adjustable on ground only. Areas: fin 0.629 m.² (6.76 sq. ft.), rudder 0.475 m.² (5.11 sq. ft.), tailplane 1.595 m.² (17.16 sq. ft.), elevator 0.894 m.² (9.62 sq. ft.). Span of tailplane 3.04 m. (10 ft.).

Landing Gear.—Fixed tail-wheel type. Oil/spring shock-absorbers. Hydraulic wheel-brakes. Steerable tail-wheel. Track 2.70 m. (8 ft. 10 in.).



The AISA I-11B (90 h.p. Continental C90 engine).

Power Plant.—One 90 h.p. Continental C90-12F four-cylinder horizontally-opposed air-cooled engine driving a two-blade Aeromatic or fixed-pitch wood airscrew. Total fuel capacity 80 litres (17.6 Imp. gallons).

Accommodation.—Two side-by-side seats with dual controls under "blister" type canopy. Baggage space aft of seats.

Dimensions.—
Span 9.340 m. (30 ft. 7 in.).
Length 6.468 m. (21 ft. 3 in.).
Height (tail down) 1.900 m. (6 ft. 3 in.).

Weights and Loadings.—
Weight empty 421 kg. (926 lb.).
Normal loaded weight 644 kg. (1,417 lb.).
Max. permissible weight (semi-aerobatic category) 670 kg. (1,474 lb.).
Max. permissible weight (full aerobatic category) 570 kg. (1,254 lb.).
Normal wing loading 48 kg./m.² (9.84 lb./sq. ft.).
Normal power loading 7.15 kg./h.p. (15.7 lb./h.p.).

Performance (at normal loaded weight).—
Max. speed 200 km.h. (124 m.p.h.).
Cruising speed 177 km.h. (110 m.p.h.).
Min. speed 76 km.h. (47.2 m.p.h.).
Rate of climb at S/L. 220 m./min. (726 ft./min.).
Service ceiling 4,700 m. (15,415 ft.).
Range 650 km. (403 miles).

CASA



The CASA-201 Alcotan Airliner (two 500 h.p. ENMA Sirio-VIIA engines).

CONSTRUCCIONES AERONAUTICAS S.A.

Head Office: Calle Del Rey Francisco No. 4, Madrid.

Works: Madrid, Getafe, Seville and Cadiz.

President: Don Victor Chavarri Anduiza.

Counsellor-Deputy: Don José Ortíz Echagüe.

Managing Director: Don Francisco Díaz Iboléon.

Consulting Engineer: Don Francisco Lozano Aguirre.

Engineer in charge of Projects: Don Pedro Huarte-Mendicoa Larraga.

Engineer in charge of Production: Don Eugenio Aguirre Castillo.

Engineer in charge of Administration: Don Emilio de la Guardia Ruiz.

This important concern has four factories wherein are built various types of all-metal military aircraft of national and foreign design for the Spanish Air Force.

At Seville, 200 Heinkel He. 111 aircraft, built by CASA as the CASA-2.111, are being completed for the Spanish Air Force in day bomber, reconnaissance bomber, trainer and command transport versions, with Rolls-Royce Merlin engines.

In 1949, CASA completed the first twin-engined aircraft of Spanish design, the CASA-201, and the airframes for a series of 112 production aircraft have been completed at the Getafe factory.

The prototype of a second twin-engined aircraft of the firm's own design, the CASA-202, flew for the first time in May, 1952, and production of 20 of these aircraft is nearing completion, also at Getafe.

The company's latest product is the twin-engined 30/38 passenger airliner known as the CASA-207. This aircraft made its first flight in September, 1955 and obtained its Certificate of Airworthiness to I.C.A.O. standards on January 17, 1958. A pre-series of 100 is now being built.

CASA is building under licence a series of fifty Dornier Do. 27 single-engined general purposes monoplanes for the Spanish Air Force.

CASA has also begun the IRAN (Inspect and Repair As Necessary) overhaul of F-86F Sabre and F-100 Super Sabre aircraft, under a Technical Assistance Agreement with North American Aviation Inc. By the end of 1957, more than 150 of these aircraft had been overhauled, and over 100 more were in hand in the Spring of 1958.

THE CASA-201 ALCOTAN.

The CASA-201, which flew for the first time in February, 1949, was the first twin-engined aircraft of original Spanish design and construction.

Several versions of the CASA-201 now being developed have the following designations and functions :—

201-A. Passenger version. Two Armstrong Siddeley Cheetah 27 engines.

201-B. Passenger version. Two ENMA Sirio-VII-A engines.

201-D. Navigation, Radio, Multi-engine and Blind-flying training aircraft. Two Armstrong Siddeley Cheetah 27 engines.

201-E. Bombing and Photographic Training aircraft. Two Armstrong Siddeley Cheetah 27 engines.

201-F and G. Same as 201-D and E, but with two ENMA Sirio-VII-A engines.

201-H. Passenger version. Two Alvis Leonides 503/7 engines.

All of the airframes for the 112 aircraft on order have been completed, and it is expected that the Sirio will be the standard engine for these. One aircraft has been fitted experimentally with two 450 h.p. Pratt and Whitney Wasp Junior engines.

Type.—Twin-engined Light Transport.

Wings.—Low-wing cantilever monoplane. Wing in three sections comprising centre-section and two tapering outer sections set at 6° dihedral. All-metal two-spar structure. Hydraulically-operated flaps inboard of ailerons, the latter being interconnected with the flaps and arranged to droop to augment flap area for landing. Wing area 41.80 m.² (450 sq. ft.).

Fuselage. — All - metal semi - monocoque structure.

Tail Unit.—Cantilever monoplane type. All-metal tailplane and fin, metal-framed fabric-covered rudder and elevators.

Landing Gear.—Retractable tail-wheel type Hydraulic operation.

Power Plant.—Two Armstrong Siddeley Cheetah 27 seven-cylinder radial air-cooled engines, each with a normal rated output of 385 h.p. and with 475 h.p. available for take-off, or two ENMA Sirio-VIIA seven-cylinder radial engines, each with a normal rated output of 440 h.p. and with 500 h.p. available for take-off, or two Alvis Leonides 503/7 nine-cylinder radial air-cooled engines, each with 520/540 h.p. available for take-off. Fuel tanks in wings.

Accommodation.—Crew of two and ten passengers. Cabin heating. Night-flying equipment.

Dimensions.—
Span 18.40 m. (60 ft. 4 in.).
Length 13.80 m. (45 ft. 3 in.).
Height 3.85 m. (12 ft. 8 in.).

Weights and Loadings (Cheetah engines).—
Weight empty 3,560 kg. (7,830 lb.).
Weight loaded 5,100 kg. (11.230 lb.).
Wing loading 122 kg./m.² (25 lb./sq. ft.).
Power loading 5.37 kg./h.p. (11.8 lb./h.p.).

Weights and Loadings (Sirio engines).—
Weight empty 3,600 kg. (7,920 lb.).
Weight loaded 5,500 kg. (12,100 lb.).
Wing loading 131 kg./m.² (26.8 lb./sq. ft.).
Power loading 6.11 kg./h.p. (13.5 lb./h.p.).

Performance (Cheetah engines).—
Max. speed 325 km.h. (203 m.p.h.).
Landing speed 112 km.h. (70 m.p.h.).
Service ceiling 5,600 m. (18,370 ft.).
Range 1,000 km. (621 miles).
Duration 4 hours.

Performance (Sirio engines).—
Max. speed 350 km.h. (219 m.p.h.).
Landing speed 117 km.h. (73 m.p.h.).
Service ceiling 6,100 m. (20,000 ft.).
Range 1,000 km. (621 miles).
Duration 4 hours.

THE CASA-202 HALCÓN.

The first prototype of this aircraft flew in May, 1952, with ENMA Beta engines, and a pre-series of 20 is nearing completion for the Spanish Government. A second prototype, flown at the beginning of 1956, has two Wright Cyclone engines and an executive transport version of the Halcón, designated CASA-202B, has this type of power plant. The Halcón was designed in accordance with British Airworthiness requirements.

Type.—Twin-engined Transport.

Wings (CASA-202).—Low-wing cantilever monoplane. Wing section NACA 23018 at root, 23009 at tip. Aspect ratio 8.11. Dihedral 6°. Chord 4.1 m. (13 ft. 5 in.) at root, 1.3 m. (4 ft. 3 in.) at tip. All-metal two-spar structure. Metal-framed fabric-covered ailerons. Total area of ailerons 4.4 m.² (47.3 sq. ft.). All-metal trailing-edge flaps. Total area of flaps 6.8 m.² (73.2 sq. ft.). Gross wing area 57.40 m.² (617.6 sq. ft.).



The CASA-202 Halcón Airliner (two 775 h.p. ENMA Beta engines).

WINGS (CASA-202B).—Basically similar to CASA-202, but with reduced span. Aspect ratio 7.56. Chord at tip 1.49 m. (4 ft. 11 in.). Total area of ailerons 3.45 m.² (37.2 sq. ft.). Gross wing area 56.0 m.² (602.8 sq. ft.).

FUSELAGE.—All-metal semi-monocoque structure.

TAIL UNIT (CASA-202).—Cantilever monoplane type. All-metal fin and tailplane, metal-framed fabric-covered rudder and elevators. Areas: fin 2.8 m.² (30.1 sq. ft.), rudder 2.3 m.² (24.7 sq. ft.), elevators (total) 4.7 m.² (50.6 sq. ft.), tailplane 7.7 m.² (82.9 sq. ft.).

TAIL UNIT (CASA-202B).—Areas: fin 4.10 m.² (44.1 sq. ft.), rudder 2.45 m.² (26.4 sq. ft.), tailplane 8.48 m.² (91.2 sq. ft.), elevators 4.72 m.² (50.7 sq. ft.). Tailplane span 7.9 m. (25 ft. 11 in.).

LANDING GEAR.—Retractable nose-wheel type. Hydraulic operation. Oleo shock-absorbers. Dual main wheels. Hydraulic brakes. Track 5.172 m. (16 ft. 11½ in.). Wheelbase 4.90 m. (16 ft. 1 in.).

POWER PLANT (CASA-202).—Two ENMA Beta 9C-29-750 nine-cylinder radial air-cooled engines, each with normal rating of 750 h.p. and with 775 h.p. available for take-off. Fuel tanks in wings, two in centre-section of 530 litres (116 Imp. gallons) each, and two in outer wings of 540 litres (119 Imp. gallons) each. Total fuel capacity 2,140 litres (470 Imp. gallons).

POWER PLANT (CASA-202B).—Two Wright Cyclone R-1820-56 nine-cylinder radial air-cooled engines, each with maximum continuous power of 1,200 h.p. and with 1,300 h.p. available for take-off. Hamilton Standard constant-speed airscrews. Six fuel tanks in centre-section and four in outer wings, with total capacity of 3,270 litres (720 Imp. gallons). Oil capacity 156 litres (34 Imp. gallons).

ACCOMMODATION (CASA-202).—Crew of three and fourteen passengers. Cabin heated and air-conditioned. Night flying equipment.

ACCOMMODATION (CASA-202B).—Crew of two and eight passengers. Executive-style interior. Cabin heated and air-conditioned. Night flying equipment.

DIMENSIONS—(CASA-202.)
Span 21.58 m. (70 ft. 9 in.).
Length 16.0 m. (52 ft. 6 in.).
Height 3.81 m. (12 ft. 6 in.).

DIMENSIONS (CASA-202B).—
Span 20.58 m. (67 ft. 6 in.).
Length 16.33 m. (53 ft. 7 in.).
Height 6.37 m. (20 ft. 11 in.).

WEIGHTS AND LOADINGS (CASA-202).—
Weight empty 5,267 kg. (11,615 lb.).
Max. disposable load 2,483 kg. (5,475 lb.).
Weight loaded 7,750 kg. (17,090 lb.).
Wing loading 135 kg./m.² (27.67 lb./sq. ft.).

WEIGHTS (CASA-202B).—
Weight empty, equipped 6,270 kg. (13,820 lb.).
Max. take-off weight 9,650 kg. (21,273 lb.).
Max. landing weight 8,500 kg. (18,739 lb.).

PERFORMANCE (CASA-202).—
Max. speed at S/L. 310 km.h. (192.5 m.p.h.).
Max. speed at 2,840 m. (9,315 ft.) 370 km.h. (230 m.p.h.).
Cruising speed (70% power) 330 km.h. (205 m.p.h.).
Landing speed 117 km.h. (72.6 m.p.h.).
Service ceiling 7,300 m. (23,950 ft.).
Service ceiling on one engine 3,000 m. (9,840 ft.).

PERFORMANCE (CASA-202B).—
Max. speed at 760 m. (2,500 ft.) 432 km.h. (268 m.p.h.).
Max. cruising speed at 2,780 m. (9,100 ft.) 398 km.h. (247 m.p.h.).
Landing speed 133 km.h. (82.5 m.p.h.).
Service ceiling 7,300 m. (24,000 ft.).
Single-engine ceiling 2,500 m. (8,200 ft.).
Take-off run 642 m. (2,115 ft.).
Landing run 820 m. (2,690 ft.).
Range at 3,000 m. (9,850 ft.) 2,750 km. (1,485 miles).

THE CASA-207 AZOR.

Ten Azors are being built for the Spanish Air Force. Eight will have Bristol Hercules engines; the others will have Pratt & Whitney R-2800 engines. All will carry 36 passengers.

TYPE.—Twin-engined Airliner.

WINGS.—Low-wing cantilever monoplane. Wing section NACA 23018 at root, NACA 23010 at tip. Aspect ratio 9. Chord 4.65 m. (15 ft. 3 in.) at root, 1.54 m. (5 ft. 1 in.) at tip. Dihedral 4°. Incidence 4°. All-metal two-spar structure. Metal framed fabric-covered ailerons. Hydraulically-operated all-metal trailing-edge flaps inboard of ailerons, the latter arranged to droop to augment flap area. Total aileron area 5.95 m.² (64 sq. ft.). Total flap area 11.67 m.² (125.6 sq. ft.). Gross wing area 85.8 m.² (923.2 sq. ft.).

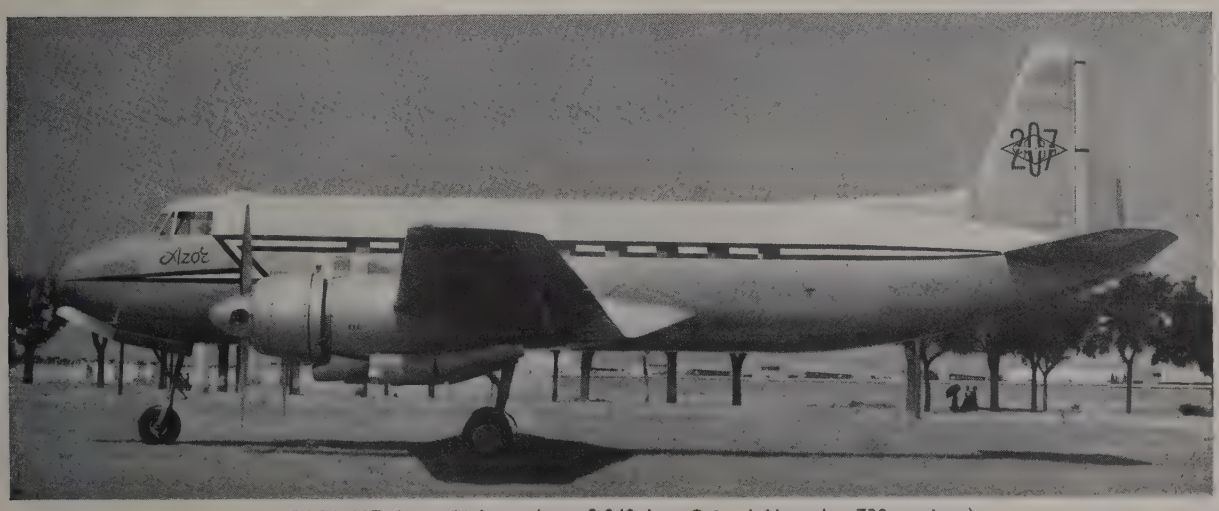
FUSELAGE.—All-metal semi-monocoque structure.

TAIL UNIT.—Cantilever monoplane type. All-metal fin and tailplane, metal-framed fabric-covered rudder and elevators. Areas: fin 6.34 m.² (68.2 sq. ft.), rudder 4.08 m.² (43.9 sq. ft.), tailplane 13.86 m.² (149.1 sq. ft.), elevators 6.26 m.² (67.4 sq. ft.). Tailplane span 10.0 m. (32 ft. 10 in.).

LANDING GEAR.—Retractable nose-wheel type. Hydraulic retraction. Oleo-pneumatic shock-absorbers. Dual main wheels. Hydraulic brakes. Wheelbase 6.155 m. (20 ft. 2 in.). Track 6.90 m. (22 ft. 7½ in.).

POWER PLANT.—Two 2,040 h.p. Bristol Hercules 730 fourteen-cylinder sleeve-valve air-cooled engines, or two 2,400 h.p. Pratt & Whitney R-2800 eighteen-cylinder radial air-cooled engines. D.H. 4/4000/6 constant-speed airscrews. Fuel tanks in wings, two in centre-section (985 litres = 217 Imp. gallons each) and two in inner wing panels (550 litres = 121 Imp. gallons each). Total fuel capacity 3,070 litres (676 Imp. gallons). Oil capacity 140 litres (30 Imp. gallons) in two tanks.

ACCOMMODATION.—Crew of 4 and 30-40 passengers. Cabin heated and air-conditioned.



The CASA-207 Azor Airliner (two 2,040 h.p. Bristol Hercules 730 engines).

DIMENSIONS.—
Span 27.80 m. (91 ft. 2¼ in.).
Length 20.85 m. (68 ft. 5 in.).
Height 7.75 m. (25 ft. 5 in.).
WEIGHTS (Hercules 730 engines).—
Weight empty 9,850 kg. (21,720 lb.).
Crew 340 kg. (750 lb.).
Passengers 2,310 kg. (5,093 lb.).
Fuel and oil 1,992 kg. (4,392 lb.).
Freight and baggage 450 kg. (992 lb.).
Water, etc. 58 kg. (128 lb.).
Weight loaded 15,000 kg. (33,075 lb.).

PERFORMANCE (Hercules 730 engines).—
Max. speed at 1,860 m. (6,100 ft.) 458 km.h. (285 m.p.h.).
Cruising speed at 3,760 m. (12,340 ft.) 428 km.h. (266 m.p.h.).
Stalling speed (with flaps) 140 km.h. (87 m.p.h.).
Service ceiling 8,600 m. (28,215 ft.).
Range (with crew of 4, 30 passengers and 15 kg.=33 lb. of baggage per passenger) 1,850 km. (1,150 miles).

PERFORMANCE (P. & W. R-2800 engines at A.U.W. of 17,000 kg.=37,500 lb.).
Max. speed at 2,600 m. (8,550 ft.) at 2,600 r.p.m. (3,600 h.p.) 465 km.h. (289 m.p.h.).
Cruising speed at 3,500 m. (11,500 ft.) 412 km./h. (256 m.p.h.) with 2,520 h.p. and 395 km.h. (245 m.p.h.) with 2,200 h.p.
Stalling speed, flaps down 145 km.h. (90 m.p.h.).
Single-engine ceiling 4,100 m. (13,500 ft.).
Still-air range (full payload) 1,950 km. (1,200 miles)

HISPANO

LA HISPANO-AVIACIÓN S.A.

HEAD OFFICE: AVENIDA DE JOSÉ ANTONIO 7, MADRID.

AIRCRAFT WORKS: CALLE SAN JACINTO 102-106, SEVILLE.

The controlling interest in Hispano-Aviacion, S.A. is held by Hispano Suiza S.A.

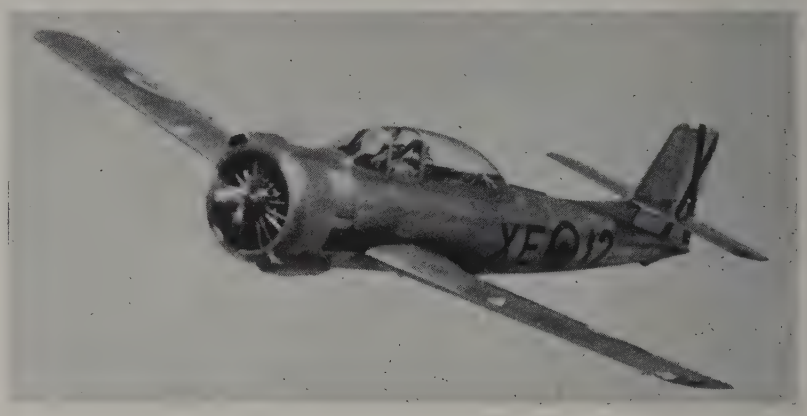
Production is centred mainly on the Messerschmitt Me 109 single-seat fighter, of which several new versions have been developed by Hispano since the war. In addition, the company has flown prototypes of an advanced trainer, designated the HA-100, and this aircraft has been ordered into production for the Spanish Air Force.

The HA-100 was designed under the direction of Professor Willi Messerschmitt, as was the new HA-200 advanced trainer, which is the first Spanish jet-propelled aircraft. Prototypes of the HA-200 are under evaluation.

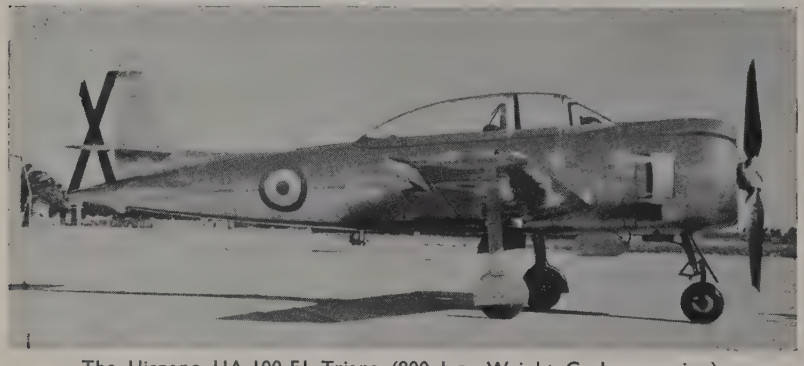
Hispano are also developing a new liaison aircraft designated the HA-231, based on the design of the HA-200.

THE HISPANO HA-231-R1 GUIÓN.

Based on the design of the HA-200 Saeta, but modified extensively, the HA-231 is reported to be under development in two forms, as a six-seat liaison aircraft and as a side-by-side two-seat basic trainer.



The Hispano HA-100-E1 Triana (755 h.p. ENMA Beta B-4 engine).



The Hispano HA-100-F1 Triana (800 h.p. Wright Cyclone engine).

It will be a low-wing monoplane, powered by two 400 kg. (880 lb.) s.t. Turbomeca Marboré II turbojet engines, and the liaison version will have three pairs of seats in tandem. No further details are available.

THE HISPANO HA-100 TRIANA.

Spanish Air Force designation: E-12.

First post-war Hispano aircraft designed under the direction of Professor Willi Messerschmitt, the HA-100 is intended to replace the Spanish Air Force's HS-42 and HA-43 advanced trainers. Four prototypes were built, as follows:—

HA-100-E1. Two prototypes with 755 h.p. ENMA Beta B-4 engine, driving either Rotol three-blade or de Havilland four-blade airscrew. First flight December 10, 1954.

HA-100-F1. Two prototypes with 800 h.p. Wright Cyclone 957C7BA1 engine, driving Aeroproducts two-blade Type A-422-E1 airscrew.

The HA-100-E1 has been ordered for service with the Spanish Air Force and the following data refers specifically to this version, although the HA-100-F1 is generally similar:—

TYPE.—Two-seat Advanced Flying and Armament Trainer.

WINGS.—Low-wing cantilever monoplane. 63_2A015, 64_2A015, 63_2A013 and 64_2A013 wing sections. Aspect ratio 6.25. Chord 1.985 m. (6 ft. 6 in.) at root, 1.274 m. (4 ft. 2 in.) at tip. Dihedral 5°. Incidence 4°. Single spar duralumin and Alclad structure. All-metal flaps. All-metal statically and aerodynamically balanced ailerons. Total area of flaps 2.275 m.² (24.5 sq. ft.). Total aileron area 1.456 m.² (15.6 sq. ft.). Gross wing area 17.35 m.² (186.6 sq. ft.).

FUSELAGE.—Circular section semi-monocoque structure of duralumin and Alclad.

TAIL UNIT.—Cantilever monoplane type. All-metal structure. Areas: fin 2.0 m.² (21.53 sq. ft.), rudder 0.68 m.² (7.3 sq. ft.), tailplane 3.14 m.² (33.5 sq. ft.), elevators 0.94 m.² (9.95 sq. ft.). Tailplane span 3.60 m. (11 ft. 9½ in.).

LANDING GEAR.—Retractable nose-wheel type. Hydraulic retraction. Hydraulic shock-absorbers. Dunlop wheels, tyres and hydraulic brakes. Track 2.12 m. (6 ft. 11 in.). Wheelbase 1.652 m. (5 ft. 5 in.).

POWER PLANT.—One 755 h.p. ENMA Beta B-4 nine-cylinder radial air-cooled engine. de Havilland 4/2000/40SAE four-blade constant-speed airscrew or Rotol R114/3-30-40 SEA/4 three-blade constant-speed airscrew. One fuel tank in fuselage (376 litres=83 Imp. gallons) and two in wings (109 litres=24 Imp. gallons each). Total fuel capacity 600 litres (132 Imp. gallons). Oil capacity 60 litres (13.2 Imp. gallons).

ACCOMMODATION.—Two seats in tandem under sliding two-section canopy. Dual controls and duplicated instrument panels.

ARMAMENT.—Two CETME 12.7 mm. machine-guns and racks for four 8 kg. rockets or 4×50 kg. bombs.

EQUIPMENT.—Complete instrumentation for blind flying training. VHF, radio compass and ILS. Oxygen equipment. Ciné camera. Vertical and oblique camera installation for reconnaissance training.

DIMENSIONS.—
Span 10.4 m. (34 ft. 1 in.).
Length 8.98 m. (29 ft. 5 in.).
Height 2.895 m. (9 ft. 9½ in.).

WEIGHTS.—
Weight empty 1,970 kg. (4,343 lb.).
Useful load 960 kg. (2,116 lb.).
Disposable load 650 kg. (1,433 lb.).
Weight loaded 2,930 kg. (6,459 lb.).

PERFORMANCE.—
Max. speed at 2,900 m. (9,500 ft.) 444 km.h. (276 m.p.h.).
Cruising speed (70% power) at 2,900 m. (9,500 ft.) 381.5 km.h. (237 m.p.h.).
Stalling speed 104 km.h. (64.5 m.p.h.).
Landing speed 128.2 km.h. (79.6 m.p.h.).
Initial rate of climb 650 m./min. (2,132 ft./min.).
Service ceiling 10,250 m. (33,620 ft.).
Range 1,323 km. (821 miles).
Endurance 3 hours, 28 mins.



The Hispano HA-200-R1 Saeta (two Turbomeca Marboré IIA turbojet engines).

THE HISPANO HA-200-R1 SAETA.
Military designation: E-14.

Designed under the direction of Professor Willi Messerschmitt, the HA-200 uses many components of the HA-100, including the wings and rear fuselage. Two prototypes have been built, of which the first made its maiden flight on August 12, 1955.

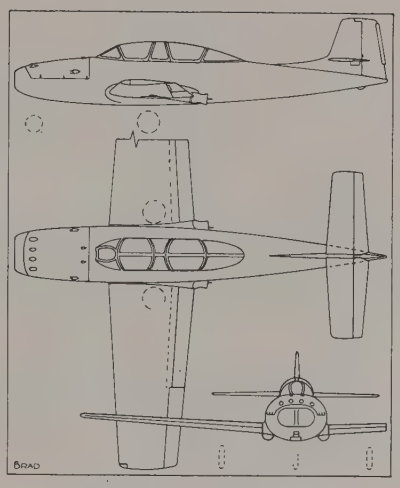
TYPE.—Twin-jet Two-seat Advanced Flying and Armament Trainer.

WINGS.—Low-wing cantilever monoplane. Aspect ratio 6.22. Chord 1.985 m. (6 ft. 6 in.) at root, 1.274 m. (4 ft. 2 in.) at tip. Dihedral 3.5°. Incidence 4°. Single-spar structure of duralumin and Alclad. Split trailing-edge flaps. Statically and aerodynamically balanced all-metal ailerons. Total aileron area 1.0462 m.² (11.25 sq. ft.). Gross wing area 17.4 m.² (187.2 sq. ft.).

FUSELAGE.—All-metal semi-monocoque structure.

TAIL UNIT.—Cantilever monoplane type. All-metal structure. Single spar variable-incidence tailplane, two-spar fin.

LANDING GEAR.—Retractable tricycle type. Hydraulic retraction. Hydraulic shock-absorbers. Non-steering nose-wheel. Hispano wheels size 20×5.25 11 (main), 19×6.00 8 (nose). Tyre pressure 73 lb./sq. in. (main), 60 lb./sq. in. (nose). Hispano brakes. Wheelbase 2.45 m. (8 ft.). Track of main wheels 3.224 m. (10 ft. 7 in.).



The Hispano HA-200-R1 Saeta.

POWER PLANT.—Two Turbomeca Marboré IIA turbojet engines (400 kg.=880 lb. s.t. each) in fuselage with air inlet in nose and jet exits below trailing-edge of wing roots. Two fuel tanks in fuselage and two in wings. Total internal fuel capacity 745 litres (164 Imp. gallons). Two fixed wing-tip tanks 240 litres (53 Imp. gallons) capacity each, fitted with fuel jettison valves.

ACCOMMODATION.—Enclosed pressurised cabin seating two in tandem with dual controls. Heating and refrigeration equipment.

EQUIPMENT.—Complete blind-flying instrument equipment, VHF, radio compass, ILS, oxygen, etc. Armament appropriate to various training functions may be fitted.

DIMENSIONS.—
Span 10.42 m. (34 ft. 2 in.).
Length 8.88 m. (29 ft. 1½ in.).
Height 3.26 m. (10 ft. 8 in.).

WEIGHTS.—
Weight empty 1,677 kg. (3,697 lb.).
Useful load 1,496 kg. (3,298 lb.).
Disposable load 1,160 kg. (2,557 lb.).
Weight loaded 3,173 kg. (6,995 lb.).

PERFORMANCE.—
Max. speed at S/L. 652 km.h. (405 m.p.h.).
Max. speed at 9,000 m. (29,520 ft.) 700 km.h. (435 m.p.h.).
Initial rate of climb 1,020 m./min. (3,345 ft./min.).
Climb to 9,000 m. (29,500 ft.) 16 min.
Service ceiling 12,000 m. (39,360 ft.).
Cruising duration 3½ hours.
Cruising range 1,700 km. (1,056 miles) at 10,000 m. (32,800 ft.).

SWEDEN

SAAB

SVENSKA AEROPLAN A.B. (SAAB AIRCRAFT COMPANY).

HEAD OFFICE : LINKÖPING.

WORKS : LINKÖPING, JÖNKÖPING, TROLLHÄTTAN AND GOTHENBURG.

President : Tryggve Holm.

LINKÖPING DIVISION (SAAB-L).

Vice-President, Aeronautical Engineering : L. Brising.

Vice-President, Production : B. Johnson.

Vice-President, Finance : T. Arnheim.

Sales Manager : A. Rydberg.

Manager, Technical Service Department : C. Larsson.

Manager, Purchasing Department : U. Rydberg.

JÖNKÖPING DIVISION (SAAB-J).

(Aircraft apparatus and equipment)

Vice-President in charge : T. Faxén.

TROLLHÄTTAN DIVISION (SAAB-T).

(Motor cars, etc)

Vice-President in charge : Svante Holm.

The Saab Aircraft Company was founded at Trollhättan in 1937 for development and production of all-metal military aircraft. In 1939 Saab took over the Aircraft Division (ASJA) of the Svenska Järnvägsverkstäderna rolling stock factory in Linköping, which had been manufacturing and developing military and civil aircraft since 1930. In connection with the merger, Saab moved its head office and engineering departments to Linköping which has since become the company's main factory. In 1950, the company acquired a factory at Jönköping for development and manufacture of aircraft and related equipment. Other post-war expansions include a bomb-proof underground factory in Linköping, as well as important new production and engineering facilities in Linköping, Jönköping, Trollhättan and Gothenburg. The Gothenburg factory is producing components for the motor-car production at Trollhättan, which began in 1949-50, and which is now on a major scale.

The capital of the company has been successively increased in connection with the large expansions that have taken place over the years, and now stands at Kr. 51,000,000. The Saab factories today employ approximately 8,000 people.

During World War II, the company supplied the Royal Swedish Air Force with large numbers of Saab-designed light bombers and fighters. In September, 1948, the first prototype of a swept-wing jet fighter, the Saab-29, made its maiden flight. The Saab-29 was the first swept-wing jet fighter to go into large-scale production and service in Western Europe and deliveries extended from May, 1951 until April, 1956.

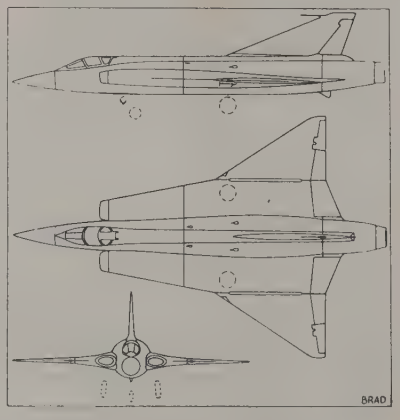
The company is currently producing the Saab-32 Lansen, a two-seat transonic all-weather combat aircraft, deliveries of which began during the latter part of 1955, and the Saab-35 Draken, a single-seat supersonic all-weather fighter which will eventually replace the Saab-29 in service with the Royal Swedish Air Force. The first production Saab-35A made its maiden flight in February, 1958.

In the civil field, the company has designed and built the Saab-90 Scandia twin-engined 32-passenger airliner, which has been described fully in earlier editions of "All the World's Aircraft," and the Saab-91 Safir three or four-seat training and touring aircraft.

SAAB-35A DRAKEN.

Swedish Air Force designation: J 35.

The Saab-35A Draken single-seat jet fighter, which has a high supersonic speed, has been designed mainly to intercept bombers in the transonic speed range, and carries full radar equipment to accomplish this under all weather conditions.



The Saab-35A Draken.

The Draken is of the "double delta" configuration, developed exclusively in Sweden, which provides relatively large space for fuel, armament and equipment in combination with low structure weight, low drag and a high air intake efficiency.

The first of three prototypes of the Saab-35 made its maiden flight on October 25, 1955.

During 1956 it was disclosed that the aircraft had gone into quantity production, and the first production Saab-35A (J 35A) made its first flight on February 15, 1958.

It has been officially announced that the J 35A has a maximum speed of Mach 1.8, as compared with the Mach 1.4 attained by the prototypes.

Three versions of the J 35 have so far been announced. These are :—

J 35A. First production version.

J 35B. Improved version with more advanced fire-control equipment for collision-course tactics and improved armament. Scheduled to go into service in the early 'sixties. Max. speed Mach 2.

J 35C. Two-seat dual-control trainer version.

The description below refers to the J 35A.

TYPE.—Single-seat Supersonic All-weather fighter.

FUSELAGE.—All-metal structure, in front and rear main sections, connected to each other by a bolt joint. Fuselage front section integral with front of centre wing structure. Two pairs of air brakes, above and below rear fuselage.

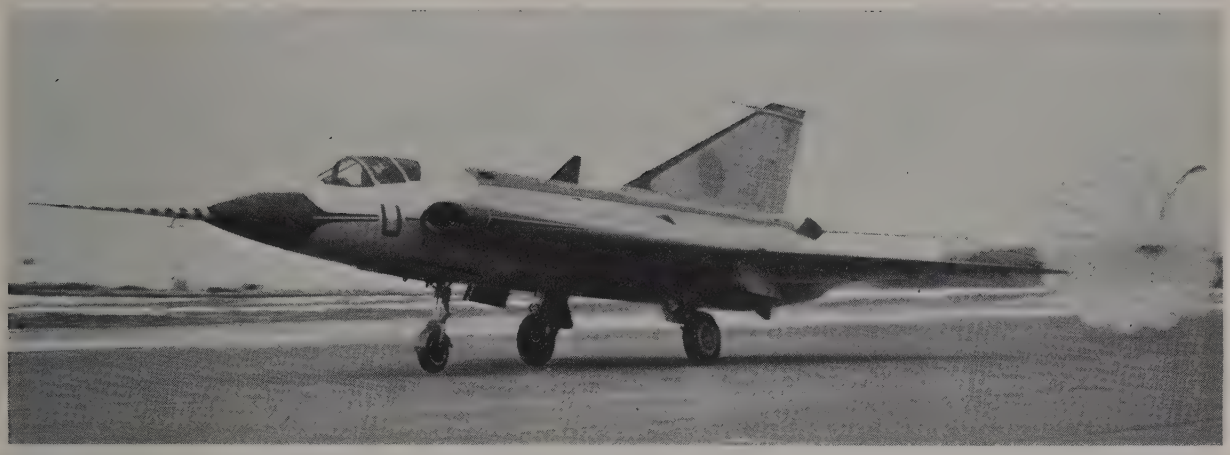
WINGS.—Cantilever "double delta" mid-wing monoplane. Sweepback on centre wing leading edge 80°, on outer wing leading edge 57°. Aspect ratio 1.77. Centre wing integral with fuselage. Outer wing, attached to centre wing with a bolt joint, has relatively thick skin sheet on a framework of spars and ribs. Wing area 50 m.² (538.2 sq. ft.).

CONTROL SURFACES.— Conventional delta-shape fin and rudder. Elevons on wing trailing edge comprise two inboard and two outboard surfaces, the latter being mass-balanced. All control surfaces servo-operated by two hydraulic tandem jacks each, fed by two separate hydraulic systems. No part of load on control surfaces is fed into stick and rudder pedals. Stick forces are generated by a unit which is sensitive to Mach number and to dynamic pressure. Three-axis Lear automatic flight control system.

LANDING GEAR.—Retractable tricycle type. Hydraulic actuation. Main units retract outward, the legs shortening during retraction to reduce the space required



The Saab-35A Draken (Svenska Flygmotor RM6 Avon turbojet engine and afterburner) in its production form.



The Saab-35A Draken All-weather Fighter (Svenska Flygmotor RM6 Avon turbojet engine and afterburner).

inside wing. Nose-wheel retracts forward. Double-disc brakes and anti-skid brake regulators. Wheel track 2.7 m. (8 ft. 10½ in.).

POWER PLANT.—One Svenska Flygmotor (Rolls-Royce licence) Avon engine (Swedish Air Force designation: RM 6) with Swedish-developed afterburner. Static thrusts approximately 5,000 kg. (11,000 lb.) without and 7,000 kg. (15,700 lb.) with afterburner. Internal fuel in integral tanks and fuselage bag tanks.

ACCOMMODATION.—Pressurised and air-conditioned cockpit, with fully-automatic Saab ejection seat.

ARMAMENT.—External armament in form of air-to-air missiles and unguided air-to-air rocket pods, or 12 × 13.5 cm. Bofors air-to-ground rockets. Two 30 mm. cannon (one in each wing) can be replaced by extra internal fuel tanks.

EQUIPMENT.—Complete radar equipment with nose scanner and pilot's scope, as well as fire control equipment.

DIMENSIONS.—
Span 9.4 m. (30 ft. 10 in.).
Length 14.2 m. (46 ft. 7 in.).

WEIGHT.—
Loaded weight (depending on armament) approx. 8,000-9,000 kg. (17,600-19,800 lb.).

PERFORMANCE.—
Max. speed Mach 1.8.
Initial rate of climb approx. 200 m./sec. (39,360 ft./min.).
Stalling speed approx. 210 km.h. (130 m.p.h.).
Landing run (without brake chute and little braking) approx. 1,200 m. (3,900 ft.).
Landing run (with brake chute and braking) approx. 600 m. (1,970 ft.).

THE SAAB-32 LANSEN.

Royal Swedish Air Force designations: A 32, J 32 and S 32.

The Saab-32 was designed and built for the Royal Swedish Air Force in accordance with a specification laid down by the Royal Swedish Air Board for an aircraft primarily intended for all-weather attack operations against ground and sea targets.

The first prototype of the Saab-32 made its first flight on November 3, 1952, powered by an early version of the British-built Rolls-Royce Avon axial-flow turbojet engine. The production A 32A, however, is fitted with the Avon RA.7R with afterburner (Swedish Air Force designation RM 5) built under licence in Sweden by Svenska Flygmotor AB. of Trollhättan.

During 1953 a Lansen prototype exceeded the speed of sound under complete control during dive tests, one of the first aircraft of its class in the World to do so.

The Lansen was ordered into quantity production in 1953, and the aircraft is now in large-scale service with the Swedish Air Force. The following versions have been announced :—

A 32A. First production version for all-weather attack duties. Deliveries began late in 1955.

J 32B. All-weather and night fighter version first flown on January 7, 1957. Differs from the A 32A mainly in having a considerably more powerful Svenska Flygmotor-built Avon engine (RM 6 in Sweden) fitted with an enlarged Swedish-developed afterburner, giving considerably increased rate of climb and speed. The J 32B also features a new and powerful armament, and a new navigation and fire control system.

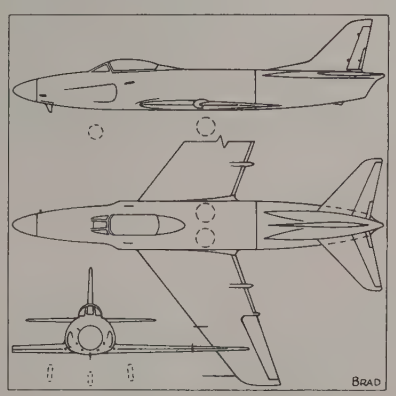
S 32C. Photographic reconnaissance version, first flown on March 26, 1957. Fitted with the most modern photographic equipment, with provision for several alternative camera installations in modified nose. Special aids make possible night photography from a wide range of altitudes. Complete electronic equipment for night navigation and radar reconnaissance. Production of substantial number is under way.

The description below refers specifically to the A 32A all-weather attack version, but is also generally applicable to the J 32B and S 32C.

TYPE.—Two-seat All-weather Attack Fighter.

WINGS.—Swept low-wing cantilever monoplane with 35° sweep-back at 25% wing chord. Thin laminar-flow wing section. Aspect ratio 4.5. All-metal flush-riveted stressed skin structure. Ailerons operated by hydraulic booster system of Saab design. Fowler flaps. Two stall fences.

FUSELAGE.—All-metal structure with flush-riveted stressed skin. Entire rear fuselage



The Saab-32 Lansen.



The Saab-32A Lansen armed with two Swedish Type 304 air-to-surface missiles.

quickly removable for access to engine. Four air-brakes in rear fuselage sides.

TAIL UNIT.—Cantilever monoplane type. Movable tailplane mounted on big fairings used to smooth the airflow around the tail-plane. Elevator operated by hydraulic booster system.

LANDING GEAR.—Retractable nose-wheel type. Hydraulically (Saab) retractable, main wheels into the fuselage, the nose wheel forwards. Goodyear wheels and brakes, with Dunlop Maxaret anti-skid device.

POWER PLANT.—One Svenska Flygmotor-built Rolls-Royce Avon RA.7R (Swedish designation RM 5) axial-flow turbojet engine, with re-heat installation. Air intakes in fuselage sides.

ACCOMMODATION.—Pressurized cockpit for pilot and observer. Ejector seats of Saab design. The aircraft may be equipped with dual controls to facilitate crew training.

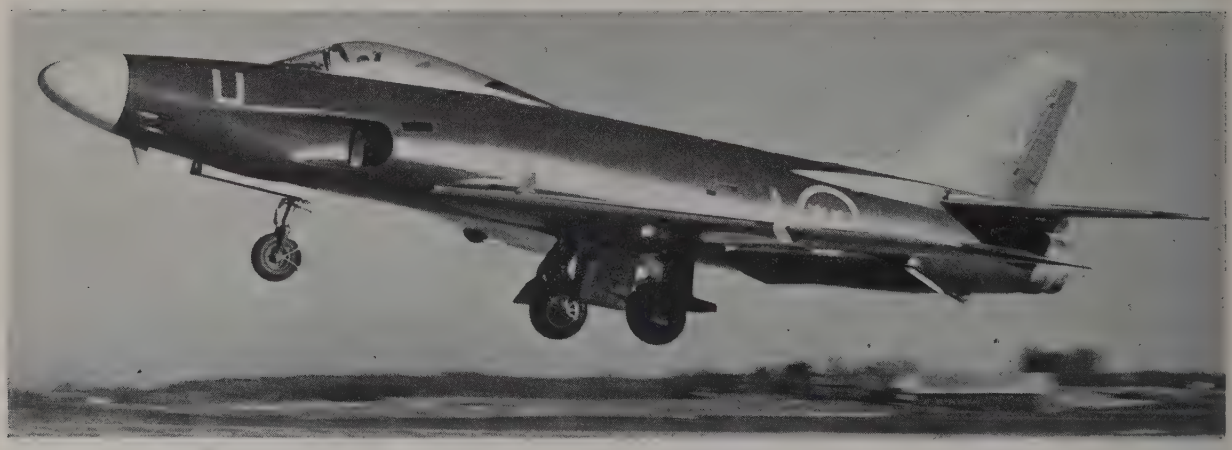
ARMAMENT.—Four fuselage-mounted 20 mm. cannon. Various combinations of under-wing stores can be carried including bombs (50, 100, 250 or 500 kg.), rockets (13.5, 15 or 18 cm. cal.), etc. The aircraft can also carry the new Type 304 air-to-surface guided missile.

DIMENSIONS.—
Span 13 m. (42 ft. 8 in.).
Length 14.65 m. (48 ft.).
Height 4.75 m. (15 ft. 6 in.).

WEIGHTS.—
Weight empty approx. 7,000 kg. (15,400 lb.).



The Saab-32A Lansen (Svenska Flygmotor RM5 Avon turbojet engine).



The Saab J 32B, the Two-seat Night and All-weather Fighter version of the Lansen.

Weight loaded approx. 10,000 kg. (22,000 lb.).

PERFORMANCE.—
Max. speed over 1,100 km.h. (700 m.p.h.).
Landing speed 200 km.h. (125 m.p.h.).
Service ceiling approx. 15,000 m. (49,200 ft.).

THE SAAB-29.

Royal Swedish Air Force designations: J 29, A 29 and S 29.

The Saab-29 was the first swept-wing jet fighter to be put into large-scale production in Western Europe. The first of three prototypes was test-flown on September 1, 1948, powered by a D.H. Ghost turbojet engine giving a static thrust of about 4,400 lb. (2,000 kg.). A series prototype made its first flight in July, 1950. All production aircraft are fitted with 5,000 lb. (2,270 kg.) static thrust Ghost engines built under licence in Sweden by Svenska Flygmotor AB (SFA) at Trollhättan. The Saab-29F version is also fitted with a Swedish-developed afterburner.

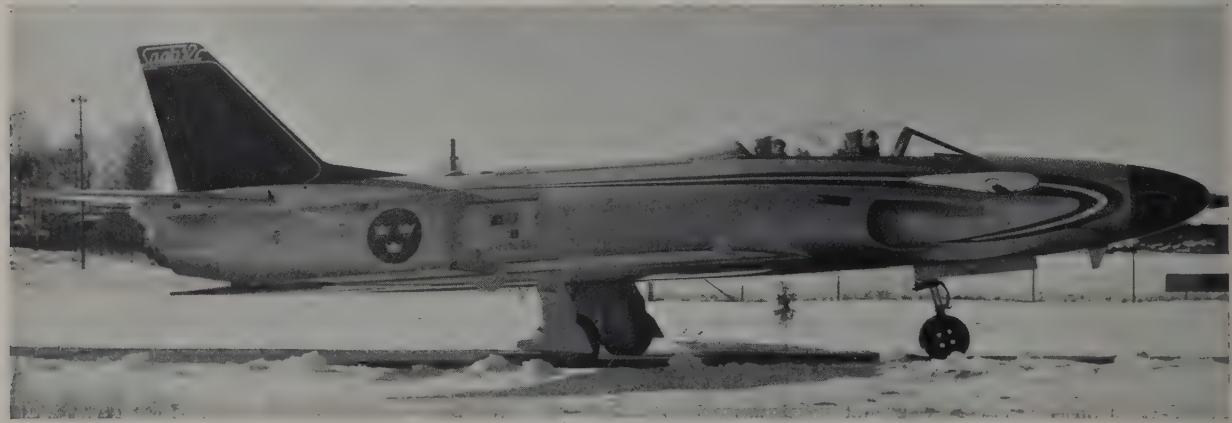
The Saab-29 series of day fighter, attack and photographic reconnaissance aircraft is in large-scale service with the Royal Swedish Air Force. The following versions of the Saab-29 have been built (only A.F. designations are used).—

J 29A. First production version. Initial aircraft featured wing air brakes, later aircraft fuselage-mounted air brakes. Deliveries started in May, 1951.

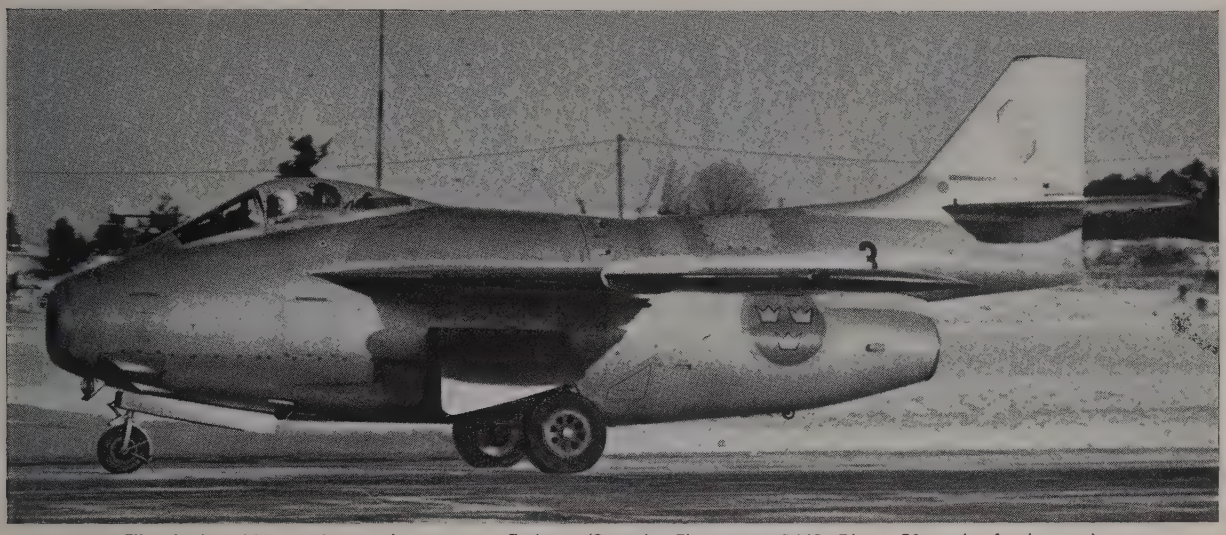
J 29B. Second production version with increased internal fuel tankage. Replaced the J 29A in production early in 1953.

A 29. Attack version identical to the J 29B. Now replaced in service by the Saab-32A (A 32A) Lansen.

S 29C. Photographic reconnaissance



The Saab S 32C Two-seat Photographic Reconnaissance version of the Lansen.



The Saab J 29F Single-seat Interceptor Fighter (Svenska Flygmotor RM2 Ghost 50 with afterburner).

version carrying up to six fully automatic cameras and improved navigation equipment. The prototype made its first flight in June, 1953. Deliveries started before the end of 1953.

J 29D. Experimental version fitted with afterburner developed by Royal Swedish Air Board and Svenska Flygmotor AB in collaboration. First flown in March, 1954.

J 29E. This version fitted with a modified outer wing giving higher critical Mach number and improved transonic flight characteristics. The new outer wing was first flight-tested in December, 1953, and was subsequently introduced on production aircraft.

J 29F. The fifth and last production version. The J 29F combines the improvements of the J 29E and the J 29D experimental afterburner-equipped version. The introduction of an afterburner has approximately doubled the climb rate of the J 29F and considerably increased the service ceiling. The first pre-production J 29F made its first flight in the late summer of 1954. A considerable number of J 29B fighters are being brought up to J 29F standard. Deliveries of the J 29F started late in 1954 and this modification work is being continued through 1958 although production of new J 29 aircraft ended in April, 1956.

A full structural description of the Saab-29 has appeared in previous editions of this Annual.

THE SAAB-91A SAFIR.

The Safir, which first flew in 1945, was originally fitted with a 130 h.p. D.H. Gipsy Major IC engine. The production model, however, is powered with a later model D.H. Gipsy Major 10 of 145 h.p. Apart from being marketed in Sweden, the Safir has been exported to various parts of the World—Argentina, Brazil, Ethiopia, Holland, India, Norway, etc.

Experimental variants of the Safir have been fitted with swept wings for research purposes.

Type.—Three-seat Low-wing Cabin monoplane.

Wings.—Cantilever low-wing monoplane. Single-spar structure in two detachable sections bolted to fuselage. Metal covering in front of spar and fabric aft. Aspect ratio 8.3; taper ratio 1 : 0.45. Wing area 13.60 m.² (146.3 sq. ft.). Ailerons have Alclad-structure with fabric covering. Trim-tab in port aileron adjustable on ground. Mechanically-operated all-metal split trailing-edge flaps between ailerons and fuselage.

Fuselage.—Monocoque structure with vertical frames, longitudinal stringers and stressed Alclad skin.

Tail Unit.—Cantilever monoplane type. Alclad structure with metal skin over fixed surfaces and fabric covering to rudder and elevators. Controllable trim-tab in starboard elevator and adjustable balance tab in rudder.

Landing Gear.—Retractable tricycle-type. Main wheels, carried on oleo-spring shock-absorber legs, retract inwards into fuselage, and nose-wheel backwards into fuselage. Mechanical operation. Hydraulically-operated wheel-brakes controlled by toe-pedals.

Power Plant.—One 145 b.h.p. D.H. Gipsy Major 10 four-cylinder in-line inverted air-cooled engine driving two-blade airscrew. Fuel capacity 110 litres (24 Imp. gallons) with 25 litres (5.5 Imp. gallons) reserve.

Accommodation.—Enclosed cabin seating three, pilot (on port) and one passenger side-by-side in front with dual control and second passenger behind and on starboard side, with luggage compartment behind pilot. Two passenger seats may be replaced by stretcher or freight. Three hinged panels for access, which can be jettisoned in emergency. Cabin interior width 1.22 m. (4 ft.).

Dimensions.—
Span 10.60 m. (34 ft. 9 in.).
Length 7.80 m. (25 ft. 7 in.).
Height 2.20 m. (7 ft. 3 in.).

Weights and Loadings.—
Weight empty 580-610 kg. (1,278-1,344 lb.) according to equipment.
Disposable load 385-415 kg. (849-915 lb.).
Weight loaded 955 kg. (2,195 lb.).
Max. overload 1,075 kg. (2,370 lb.).
Wing loading (at normal loaded weight) 73.2 kg./m.² (15 lb./sq. ft.).
Power loading 7.1 kg./h.p. (15.66 lb./h.p.).

Performance.—
Max. speed 265 km.h. (164 m.p.h.).
Max. cruising speed 248 km.h. (154 m.p.h.).
Economical cruising speed 235 km.h. (146 m.p.h.).
Stalling speed 85 km.h. (53 m.p.h.).
Rate of climb at sea level 300 m./min. (985 ft./min.).
Cruising range 960 km. (585 miles).

THE SAAB-91B SAFIR.

Royal Swedish Air Force designation: Sk 50.

This version of the Safir differs from the 91A mainly in having a 190 h.p. Lycoming O-435-A engine. The first prototype made its maiden flight on January 18, 1949.

In 1951, the Royal Swedish Air Force adopted the Saab-91B as a standard primary trainer and a considerable number was ordered. Owing to Saab's other military commitments, the production of these aircraft was subcontracted to the Dutch De Schelde factory at Dordrecht. Following increased production capacity at Saab's main plant in Linköping, Safir production was resumed in Sweden at the end of 1954.

The 91B may be equipped to carry two 8 mm. guns and eight 63 mm. rocket projectiles or training bombs. The Safir is now being used by the air forces of



The Saab-91B Safir Trainer in the colours of the Royal Norwegian Air Force.

Sweden, Norway and Ethiopia, and has also attained a unique position as a trainer for the pilots of the following airlines—KLM, SABENA, Deutsche Lufthansa and Air France.

In the Swedish Air Force, pilots go direct from the Safir to an advanced jet trainer, at present the D. H. Vampire Trainer (J 28C).

POWER PLANT.—One 190 h.p. Lycoming O-435-A six-cylinder horizontally-opposed air-cooled engine driving a Hartzell two-blade variable-pitch airscrew. Petal-type cowling. Fuel capacity 175 litres (38.5 Imp. gallons).

DIMENSIONS.—
Span 10.6 m. (34 ft. 9 in.).
Length 7.95 m. (26 ft.).
Height on ground 2.2 m. (7 ft. 2 in.).

WEIGHTS AND LOADINGS.—
Weight empty 720 kg. (1,590 lb.).
Weight loaded (Utility category) 1,215 kg. (2,686 lb.).
Weight loaded (Aerobatic category) 1,050 kg. (2,320 lb.).
Wing loading (Aerobatic) 77.2 kg./m.² (15.8 lb./sq. in.).
Power loading (Aerobatic) 5.53 kg./h.p. (12.2 lb./h.p.).

PERFORMANCE.—
Max. speed 275 km./hr. (171 m.p.h.).
Max. cruising speed 245 km./hr. (152 m.p.h.).
Econ. cruising speed at S/L 232 km./hr. (144 m.p.h.).
Rate of climb at S/L 5.8 m./sec. (1,140 ft./min.).
Service ceiling 6,250 m. (20,500 ft.).
Cruising range 1,075 km. (670 s.t. miles).

THE SAAB-91C SAFIR.

In September, 1953, a third version of the Safir made its first flight. The new version, which was later put into quantity production, is designated the Saab-91C and differs mainly from the three-seat 91B version in having comfortable accommodation for four people and luggage.



The Saab-91C Safir Four-seat Tourer (190 h.p. Lycoming engine).

In addition to its use as a private, business, taxi and aerial mapping aircraft the 91C version can easily accommodate a stretcher case and a medical attendant, and by removing the rear seats a quarter-ton of cargo can be carried. It is also suitable for use as a trainer.

POWER PLANT.—
Same as for the Saab-91B.

DIMENSIONS.—
Same as for the Saab-91B.

WEIGHTS AND LOADINGS.—
Weight empty 745 kg. (1,650 lb.).
Weight loaded 1,215 kg. (2,686 lb.)
Wing loading 89.3 kg./m.² (18.2 lb./sq. ft.).
Power loading 6.4 kg./h.p. (14.1 lb./h.p.).

PERFORMANCE.—
Max. speed 270 km.h. (168 m.p.h.).
Max. cruising speed 240 km.h. (150 m.p.h.).
Econ. cruising speed at S/L. 227 km.h. (141 m.p.h.).
Rate of climb at S/L. 4.25 m./sec. (840 ft./min.).
Service ceiling 5,100 m. (16,800 ft.).
Cruising range 960 km. (600 miles).

THE SAAB-91D SAFIR.

The Saab-91D is a development of the 91B and C versions but is powered by the new four-cylinder 180 h.p. Lycoming O-360-A1A engine in place of the earlier six-cylinder 190 h.p. O-435A engine. The new power-plant has made possible the installation of a new constant-speed airscrew and a more powerful generator for a generous electric and radio equipment. New brakes of the Goodyear single-disc type are also fitted. Externally the new version differs from its predecessors mainly through the modified air-intake and the airscrew spinner.

The modifications have made possible a reduction of the empty weight by 45 kg. (100 lb.) and, therefore, performances are practically unchanged at the same useful load despite the reduction in engine power. The increased weight margins make it possible to carry more load, equipment, etc.

An order for 20 Saab-91D trainers for the Finnish Air Force was announced in July, 1958.

DIMENSIONS.—
Same as for other versions.

WEIGHTS.—
Max. T.O. weight 1,205 kg. (2,657 lb.).

PERFORMANCE.—
Max. speed 265 km.h. (165 m.p.h.).
Normal cruising speed 235 km.h. (146 m.p.h.).
Econ. cruising speed 220 km.h. (136 m.p.h.).
Service ceiling 5,000 m. (16,400 ft.).
Cruising range 1,000 km. (620 miles).



The Saab-91D Safir (180 h.p. Lycoming O-360 engine).

SWITZERLAND

THE FEDERAL AIRCRAFT FACTORY

EIDG. FLUEZEUGWERK — FABRIQUE FEDERALE D'AVIONS (Federal Aircraft Factory).

HEAD OFFICE AND WORKS: EMMEN (LUCERNE).
Director: M. Buri.

This official Government establishment manufactures aircraft for the Swiss Army Air Corps. It is not in a position to provide details of its current activities.

FFA

FLUG- & FAHRZEUGWERKE A.G.

HEAD OFFICE AND WORKS: ALTENRHEIN BEI RORSCHACH.
President: Dr. C. Caroni.
Works Director: O. Eitel.
Technical Director: Dr. Ing. H. L. Studer.

This firm, formerly known as A.G. für Dornier Flugzeuge was originally the Swiss branch of the German Dornier company. It is now entirely a Swiss company and builds aircraft for the Swiss Government only.

This company has, until recently, been engaged in the development of a single-seat jet fighter which was designed to meet a Swiss Air Force specification for a tactical fighter capable of operating from short runways situated in narrow valleys at considerable altitudes above sea-level. The main requirements were, therefore, good high speed and climb performances, short landing and take-off distances, a small radius of turn and good low-speed behaviour.

The first prototype, known as the P-16 and powered by an Armstrong Siddeley Sapphire turbojet, made its first flight on April 28, 1955, and in preliminary trials it showed excellent flying qualities, especially in the low-speed range. It was subsequently destroyed in an accident. A second prototype, redesignated P-1604 and with numerous design changes, flew for the first time on June 16, 1956, and exceeded Mach 1 for the first time two months later. A third prototype made its first flight on April 4, 1957. Three more prototypes were scheduled for completion, but work on these was suspended in the Spring of 1958 following a further accident to one of the prototypes.

PILATUS

PILATUS FLUGZEUGWERKE A.G.

HEAD OFFICE AND WORKS: STANS, NEAR LUCERNE.
Commercial Manager: H. F. Alioth.
Technical Manager: Dipl. Ing. H. Fierz.

Pilatus Flugzeugwerke A. G. was formed in December, 1939, with a capital of two million Swiss francs and it began work in September, 1941. A founder's syndicate was formed in 1938 under the leadership of M. E. Bührle, the Swiss industrialist and owner of the Oerlikon Company, of which the Pilatus Company is now a subsidiary.

The first product of the company was the SB-2 Pelican, a four/six-seat cabin monoplane which was developed by the Swiss Aerotechnical Association at the Swiss Institute of Technology at Zürich in collaboration with the Pilatus company.

Later productions were the P-2 advanced training monoplane, which was supplied in a small quantity to the Swiss Air Force, and the P-4 five-seat cabin monoplane.

The latest Pilatus product is the P-3 advanced training monoplane, the prototype of which made its first flight on September 3, 1953. A military version, is in production for the Swiss Air Force and is described hereafter.

THE PILATUS P-3.

The Model P-3, of which a series of 60 is being built for the Swiss Air Force, is suitable for *ab initio* and advanced training, including all aerobatics and inverted flight for short periods, night flying, instrument and blind flying, and weapon training.

In the Swiss Air Force, these aircraft will be used for "all-through" training prior to advanced training on de Havilland Vampire jet-trainers.

Optional equipment includes a removable hood over the rear seat, oxygen apparatus, one machine-gun with 180 rounds of ammunition in a pod below the port wing, racks for two practice bombs below the starboard wing, one training rocket launcher beneath each wing and a gun camera.

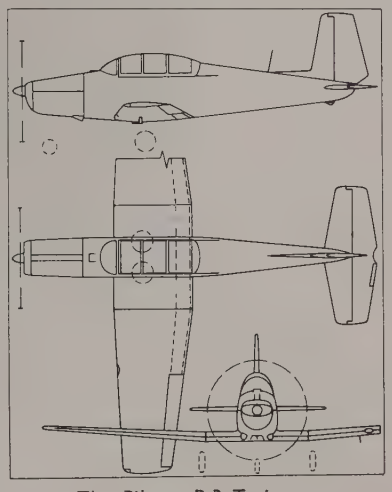
TYPE.—Two-seat Advanced Trainer.

WINGS.—Low-wing cantilever monoplane. NACA Series 64A wing section with 12% t/c ratio. Aspect ratio 6.55. Chord 1.9 m. (6 ft. 2¾ in.) at root, 1.14 m. (3 ft. 8¾ in.) at tip. Dihedral 3° on upper surface of wing. Incidence +1° at root, −1° at tip. Sweepback 1°—at 25% of chord. Single-spar aluminium-alloy structure. Ailerons and electrically-actuated slotted flaps of similar construction. Total area of ailerons 1.66 m.² (17.8 sq. ft.). Total area of flaps 2.03 m.² (21.8 sq. ft.). Gross wing area 16.5 m.² (177 sq. ft.).

FUSELAGE. — All - metal semi - monocoque structure.

TAIL UNIT.—Cantilever monoplane type. All-metal structure. Areas: fin 0.72 m.² (7.7 sq. ft.), rudder 0.73 m². (7.8 sq. ft.), tailplane 2.0 m.² (21.5 sq. ft.), elevators 1.25 m.² (13.4 sq. ft.). Span of tail 3.25 m. (10 ft. 8 in.).

LANDING GEAR.—Retractable tricycle type. Electro-mechanical retraction, with provision for manual lowering in emergency. Pilatus oil/steel spring shock-absorbers. Goodyear wheels and disc brakes. Wheelbase 2.37 m. (7 ft. 6 in.). Track of main wheels 2.62 m. (8 ft. 6 in.).



The Pilatus P-3 Trainer.

POWER PLANT.—One 260 h.p. Lycoming GO-435-C2A six-cylinder horizontally-opposed air-cooled engine. Hartzell three-blade constant-speed metal airscrew. Two fuel tanks in leading-edge of centre-section with total capacity of 160 litres (35.2 Imp. gallons). Oil capacity 11.3 litres (2.4 Imp. gallons).

ACCOMMODATION.—Crew of two in tandem with dual controls. One-piece sliding canopy operated by crank and jettisonable in emergency. Adjustable seats. Full instrumentation for day and night flying. Combined ventilation, heating and defrosting system. R/T transmitter and receiver.

OPTIONAL EQUIPMENT.—Provision for one machine-gun, two launchers for 5 cm. Oerlikon training rockets, racks for two practice bombs, gun camera, oxygen equipment.

DIMENSIONS.—
Span 10.40 m. (34 ft. 1 in.).
Length 8.75 m. (28 ft. 8 in.).
Height 3.05 m. (10 ft.).

WEIGHTS.—
Weight equipped 1,110 kg. (2,447 lb.).
Weight loaded 1,415 kg. (3,120 lb.).
Max. permissible loaded weight, with optional equipment, 1,500 kg. (3,307 lb.).

PERFORMANCE (at 1,500 kg. = 3,307 lb. A.U.W.).—
Max. speed from S/L. to 2,000 m. (6,560 ft.) 310 km.h. (192.5 m.p.h.).
Max. diving speed 500 km.h. (310 m.p.h.).
Max. cruising speed 275 km.h. (170 m.p.h.).
Econ. cruising speed 252 km.h. (157 m.p.h.).
Min. speed 100 km.h. (62 m.p.h.).
Rate of climb at S/L. 420 m./min. (1,378 ft./min.).
Rate of climb at 2,000 m. (6,560 ft.) 222 m./min. (722 ft./min.).
Service ceiling 5,500 m. (18,040 ft.).
Absolute ceiling 6,100 m. (20,000 ft.).
Take-off distance to 15 m. (50 ft.) at S/L. on hard runway 342 m. (374 yds.).
Landing distance from 15 m. (50 ft.) at S/L. on hard runway 390 m. (427 yds.).
Max. still air range 750 km. (465 miles).



The Pilatus P-3 Two-seat Advanced Trainer (260 h.p. Lycoming engine).

TURKEY

M.K.E.K.

MAKINA VE KIMYA ENDUSTRISI KURUMU.

HEAD OFFICE: M.K.E. GENEL MÜDÜRLÜK, ANKARA.

AIRCRAFT ENGINEERING DIVISION: M.K.E. GENEL MÜDÜRLÜK, ANKARA.

AIRCRAFT FACTORY: M.K.E. UCAK FB., ETIMESGUT, ANKARA.

General Manager, M.K.E.K.: Fuat Yücesoy, M.Sc. (Mech.E.).

Manager, Aircraft Factory: Yavuz Kansu, M.Sc.(Ae.E.).

Design and Inspection: Sukru Yazicioglu, B.Sc.(Mech.E.).

Production: Sedat Tangudur, M.Sc. (Ae.E.).

Planning: Turgut Ozkan, M.Sc.(Ae.E.).

The Aircraft Factory of the M.K.E.K. was originally founded by the Turkish Air League (Turk Hava Kurumu) in 1941.

In 1952 the factory was taken over by the M.K.E.K., an official establishment which includes the principal branches of the mechanical and chemical industries in Turkey. Aircraft manufacture in Turkey is now being undertaken solely by this State organisation.

THE M.K.E.K. MODEL 3.

This will be a tandem two-seat jet-powered basic trainer, all details of which are at present withheld.

THE M.K.E.K. MODEL 4 UGUR (LUCK).

The Model 4 military two-seat tandem primary trainer is in service in the Turkish Air Force. Examples have also been presented to the Royal Jordanian Air Force.

TYPE.—Two-seat Primary Trainer.

WINGS.—Low-wing cantilever monoplane. Clark YH wing section. Aspect ratio 5.7. Mean aerodynamic chord 1.674 m. (5 ft. 6 in.). Dihedral 7.5°. Incidence 2°. Two-spar wood structure with plywood coverings. Conventional all-wood split flaps and ailerons. Total area of flaps 1.1 m.² (11.8 sq. ft.). Total area of ailerons 1.36 m.² (14.6 sq. ft.). Gross wing area 15.9 m.² (171 sq. ft.).

FUSELAGE.—All-wood plywood-covered structure.

TAIL UNIT.—Cantilever monoplane type. Wood frames with plywood-covered fixed surfaces and fabric-covered rudder and elevators. Areas: fin 0.2 m.² (2.15 sq. ft.), rudder 0.9 m.² (9.6 sq. ft.), tailplane 1.7 m.² (18.3 sq. ft.), elevators 1.1 m.² (11.8 sq. ft.). Span of tail 2.7 m. (8 ft. 10 in.).

LANDING GEAR.—Fixed type. Dowty liquid-spring shock-absorbers. Goodyear wheels and hydraulic brakes. Track 2.25 m. (7 ft. 4½in.).

POWER PLANT.—One 145 h.p. Turkish-built D.H. Gipsy Major four-cylinder inverted air-cooled engine. Fairey-Reed fixed-pitch metal airscrew. Fuel tanks in wings. Total internal fuel capacity 20 Imp. gallons (90 litres).

ACCOMMODATION.—Tandem cockpits under continuous transparent canopy. Dual controls. Adjustable seats.

DIMENSIONS.—
Span 9.5 m. (31 ft. 2 in.).



The M.K.E.K. Model 4 Ugur Primary Trainer (145 h.p. Gipsy Major engine).

Length 7.5 m. (24 ft. 7 in.).
Height 2.16 m. (7 ft.).

WEIGHTS.—
Weight loaded 923 kg. (2,030 lb.).

PERFORMANCE.—
Max. speed at S/L. 216 km.h. (135 m.p.h.).
Cruising speed 192 km.h. (120 m.p.h.).
Stalling speed 72 km.h. (45 m.p.h.).
Initial rate of climb 244 m./min. (800 ft./min.).
Service ceiling 4,575 m. (15,000 ft.).
Normal range 512 km. (320 miles).
Take-off distance to clear 15 m. (50 ft.) 335 m. (366 yds.).
Landing distance from 15 m. (50 ft.) 366 m. (400 yds.).

THE M.K.E.K. MODEL 5

TYPE.—Twin-engined Light Ambulance.

WINGS.—Low-wing cantilever monoplane. NACA 23018-23012 wing section. Aspect ratio 7.65. Dihedral 7°. Incidence 3°. Chord 2.50 m. (8 ft. 2½ in.) at root, 1.292 m. (4 ft. 3 in.) at tip. One-piece structure with two box spars, plywood ribs and plywood stressed-skin covering. Split-type all-wood ply-covered flaps. Differentially-operated all-wood ply-covered slotted ailerons. Fixed "letter-box" type slots in leading-edge of wing ahead of ailerons. Total flap area 1.436 m.² (15.4 sq. ft.). Total aileron area 2.80 m.² (30.1 sq. ft.). Gross wing area 28 m.² (300 sq. ft.).

FUSELAGE.—All-wood monocoque structure with vertical frames, longitudinal stringers and stressed plywood skin.

TAIL UNIT.—Cantilever monoplane type. Single-piece tailplane with twin fins and rudders as endplates. Tailplane has two-spar structure with plywood covering. Single-piece elevator has wood framework and fabric covering, and has controllable trim-tab in centre. Vertical surfaces are of wood with plywood covering for fins and fabric covering for rudders. Trim-tab in port rudder adjustable from pilot's cockpit. Areas: fins 1.77 m.² (19.0 sq. ft.), rudders 1.34 m.² (14.4 sq. ft.), tailplane 3.10 m.² (33.3 sq. ft.), elevator 2.14 m.² (23.0 sq. ft.). Tailplane span 4.15 m. (13 ft. 7 in.).

LANDING GEAR.—Fixed tail-wheel type. Main wheels on J.A.R.U. oleo-pneumatic shock-absorber legs. Dunlop differentially-operated pneumatic wheel brakes. Oleo-sprung fully-castoring tail-wheel. Track 3.60 m. (11 ft. 9½ in.).

POWER PLANT.—Two 130 h.p. D.H. Gipsy Major four-cylinder in-line inverted air-cooled engines. Two-blade MKEK wood fixed-pitch airscrews. Two welded aluminium sheet fuel tanks in wings, one on each side of fuselage inboard of engine nacelles. Total fuel capacity 300 litres (66 Imp. gal.). Welded aluminium oil tank in each engine nacelle. Total oil capacity 20 litres (4.5 Imp. gal.).

ACCOMMODATION.—Enclosed accommodation for pilot and co-pilot side-by-side with dual controls. Door to flight compartment on starboard side. Cabin takes one to five stretchers, with seat for medical attendant. Large door on starboard side for loading stretchers. Main cabin sound-proofed, cockpit and cabin heated separately. Individual ventilating arrangements.

DIMENSIONS.—
Span 14.64 m. (48 ft.).
Length 10 m. (32 ft. 9½ in.).
Height 3.10 m. (10 ft. 2 in.).

WEIGHTS.—
Weight empty 1,450 kg. (3,190 lb.).
Weight loaded 1,900 kg. (4,180 lb.).

PERFORMANCE.—
Max. speed at S/L 205 km.h. (127 m.p.h.).
Cruising speed 160 km.h. (99 m.p.h.).
Min. speed (with flaps) 100 km.h. (62 m.p.h.).
Initial rate of climb 192 m./min. (630 ft./min.).
Service ceiling 4,000 m. (13,120 ft.).
Range 650 km. (405 miles).
Take-off run 210 m. (230 yds.).
Landing run 195 m. (213 yds.).

THE M.K.E.K. MODEL 6

The M.K.E.K. Model 6 is a two-seat, high-wing training sailplane. It has a wooden monocoque fuselage of circular cross-section and the wing is a wooden single-spar structure with constant taper in chord and thickness. The tail-unit is a cantilever monoplane structure and the landing-gear consists of a skid under the fuselage and a single wheel. An enclosed cabin in the nose accommodates the crew of two side-by-side.

DIMENSIONS.—
Span 16 m. (52 ft. 6 in.).
Length 7.9 m. (25 ft. 11 in.).
Wing area 22.83 m.² (245 sq. ft.).
Aspect ratio 11.2

WEIGHT AND LOADING.—
Weight empty 260 kg. (572 lb.).
Weight loaded 420 kg. (930 lb.).
Wing loading 18.4 kg./m.² (3.77 lb./sq. ft.).

PERFORMANCE.—
Max. gliding speed 181 km.h. (112 m.p.h.).
Min. speed 53.5 km.h. (33.2 m.p.h.).
Max. permissible diving speed 502 km.h. (312 m.p.h.).

THE UNITED STATES OF AMERICA

THE DESIGNATION OF AMERICAN SERVICE AIRCRAFT.

The U.S. Air Force and U.S. Navy use separate and distinctive systems to designate their aircraft, while the U.S. Army has recently begun to use a system similar to that of the U.S.A.F. The three schemes currently in use are described below.

The U.S. Air Force.

Aircraft of the U.S.A.F. are identified by a system in which the function of the aircraft is shown by letters.

B	Bomber	K	Tanker	S	Search and Rescue
C	Cargo and Transport	L	Liaison	T	Trainer
F	Fighter	Q	Target and Drone	V	Convertiplane
H	Helicopter	R	Reconnaissance	X	Special Research

These symbols are used either singly or, where an aircraft fulfils more than one function, in combination (*i.e.* KC, Tanker Transport, RB, Reconnaissance-Bomber, etc.), the symbols being followed by a number to indicate the model, the numbers running consecutively throughout the class or function irrespective of manufacture. The letters A, for amphibian ; D, director for drones and missiles ; E, exempt on special test or attached to non-military agency ; G, carrier of operational missiles or parasites ; M, missile ; U, utility ; V, administrative transport ; and W, weather reconnaissance, are used in conjunction with other functional letters, but never alone.

Model changes are indicated by letters immediately following the basic model number (*i.e.* F-100A, F-100F, etc.). These qualifying letters usually indicate changes in power-plant, structure and/or equipment which affect interchangeability of parts and components, maintenance or tactical use.

The prefixes X, to indicate prototype ; Y, limited procurement for service trials ; and Z, obsolete ; are still used.

U.S. Naval Aviation.

U.S. Naval aircraft are designated by a system which incorporates letters to define the function and identify the manufacturer of the aircraft, and numbers to indicate the model and modifications of the model.

The functions of fixed-wing piloted aircraft are covered by the following letters :—

A	Attack	R	Transport	U	Utility
F	Fighter	S	Anti-submarine	V	Convertiplane
O	Observation	T	Trainer	W	Special Search
P	Patrol				

Helicopters have the symbol H with additional qualifying functional letters, thus :—

HH	Search and Rescue	HR	Transport	HT	Training
HO	Observation	HS	Anti-submarine	HU	Utility

A series of suffix letters to follow the model number is also used to indicate special modifications or specially-equipped versions of otherwise standard types. These are as follows :—

A	Amphibian	J	Target Tug	R	Transport
B	Special Armament	K	Target Drone	S	Anti-submarine Warfare equipment
C	Carrier conversion of non-carrier type	L	Searchlight or winterised	T	Training
		M	Missile launcher	U	Utility
D	Drone Control	N	Night-operating aircraft	W	Special Search
E	Special Electronic Gear	P	Photo-Reconnaissance	Z	Administrative
G	Search and Rescue	Q	Counter-measures Aircraft		
H	Ambulance				

The individual aircraft designations are made up of the functional letter, a model number, the manufacturer's letter and following a hyphen, a modification or mark number. For example, AD-1 broken down to its component symbols indicates that the aircraft is an Attack type (A) built by Douglas (D) and that it is the first (-1) variation or mark of the basic type. Developments of this aircraft are the AD-2, AD-3, AD-4, etc. Typical specially equipped versions of this aircraft, indicated by suffix letters, are the AD-3Q (radar counter-measures version), AD-4N (night bomber version) and AD-5W (special search version). The next entirely new Attack design by Douglas was the A2D-1.

The list below details the letters which have been allotted to aircraft manufacturers :—

B	Beech Aircraft Corporation Boeing Airplane Company	M	Martin Company
		N	Gyrodyne Company of America, Inc.
C	de Havilland Aircraft of Canada, Ltd.	P	Vertol Aircraft Corporation
D	Douglas Aircraft Company, Inc.	Q	Fairchild Engine and Airplane Corporation
E	Cessna Aircraft Company, Inc. Hiller Aircraft Corporation.	R	Ryan Aeronautical Company Radioplane Division, Northrop Aircraft, Inc.
F	Grumman Aircraft Engineering Corporation	S	Sikorsky Aircraft (United Aircraft Corporation)
H	McDonnell Aircraft Corporation	T	Northrop Aircraft, Inc.
J	North American Aviation, Inc.	U	Chance Vought Aircraft, Inc.
K	Kaman Aircraft Corporation.	V	Lockheed Aircraft Corporation
L	Bell Helicopter Corporation	Y	Convair Division, General Dynamics Corporation.

U.S. Army Aviation.

The U.S. Army allots specific designations to its aircraft on the U.S.A.F. pattern. Those already announced are :—

AO	Observation (fixed-wing)	AC	Cargo
HO	Observation (rotary-wing)	AR	Reconnaissance

It has also selected its own (Indian tribal) names for most of the aircraft at present in, or about to go into, service ; the exceptions being those aircraft which already have well-known popular names.

ACME

AIR CRAFT MARINE ENGINEERING COMPANY.

HEAD OFFICE : 7800 GLORIA STREET, VAN NUYS, LOS ANGELES, CALIFORNIA.

President : Robert M. Berns.

This company was formed in September 1954 to design and build the prototype of a twin-jet amphibian executive aircraft named the Anser. Its President was formerly a design engineer with Lockheed Missile Systems Division and the company's design team includes engineers from most of the other major airframe companies in Southern California.

The Anser is designed to meet CAR 04b requirements, enabling it to be used as a commercial transport. A prototype is being built and was scheduled to fly in the second half of 1958.

THE ACME ANSER.

The Anser is an eight-seat amphibian powered by two Continental Model 420 engines. It incorporates many advanced features, including a hull design based on the latest NACA tank test data, a boundary layer control system, special crash-survival features and a retractable outboard motor to assist taxiing on the water in confined spaces.

TYPE.—Eight-seat Amphibian.

WINGS.—Cantilever shoulder-wing monoplane. NACA 7-series luminar-flow section. Chord 7 ft. 6 in. (2.29 m.) at root, 4 ft. (1.22 m.) at tip. Thickness/chord ratio 15% at root, 12.2% at tip. Sweepback on leading-edge 11°. Dihedral 1.5°. All-metal two-spar structure, with honeycomb top skin, light alloy lower skin and Fiberglas leading-edge section which forms an integral fuel tank. Metal ailerons and flaps of simplified structure with plastic foam filling. Boundary layer control system for both area suction and super-circulation over ailerons and flaps.

HULL.—Basic structure of magnesium castings with honeycomb skin panels of Fiberglas. Separate tail-cone of similar construction, containing retractable 20 h.p. outboard motor.

TAIL UNIT.—"Butterfly" type, consisting of tailplane and elevators set at an acute angle. Metal structure of simplified design with plastic foam core.

LANDING GEAR.—Retractable tricycle type. Levered suspension units with Cleveland Pneumatic liquid-spring shock-absorbers. Main units are pivoted on retractable sponsons which stabilize the aircraft on water when extended horizontally. Wheel track 12 ft. (3.66 m.). Wheelbase 13 ft. (3.96 m.).

POWER PLANT.—Two Continental (Turbomeca) Model 420 turbofan engines, each giving 790 lb. (358 kg.) s.t. Complete power plant nacelles designed to "plug-in" at junction of wing trailing-edge and fuselage, to speed servicing and removal. Fuel in two wing leading-edge tanks, each with capacity of 65 U.S. gallons (245 litres). Additional 180 U.S. gallon (682 litres) bag-type tank in hull aft of cabin. Permanently-fixed wing-tip tanks, each with capacity of 86 U.S. gallons (323 litres). Total fuel capacity 480 U.S. gallons (1,818 litres).

ACCOMMODATION.—Pressurised cabin seating crew of two and six passengers in two rows of three. Cabin lined with eurethene foam for sound-proofing and shock-absorption. Dimensions of cabin : width 5 ft. 8 in. (1.73 m.), length 10 ft. (3.05 m.), height 4 ft. 11 in. (1.50 m.). Cabin volume 280 cub. ft. (7.93 m.³). Space for 80 cub. ft. (2.26 m.³) baggage aft of cabin.

DIMENSIONS.—
Span 46 ft. (14.02 m.).
Length 38 ft. (11.58 m.).
Height 11 ft. 6 in. (3.50 m.).

WEIGHTS.—
Useful load 1,830 lb. (830 kg.).
Fuel 3,216 lb. (1,460 kg.).
Weight loaded 8,900 lb. (4,037 kg.).

PERFORMANCE (estimated).—
Max. speed 370 m.p.h. (595 km.h.).
Cruising speed 340 m.p.h. (547 km.h.).
Landing speed 45 m.p.h. (72 km.h.).
Rate of climb at S/L 1,200 ft./min. (365 m./min.).
Range 1,160 miles (1,867 km.).

AERO

AERO DESIGN AND ENGINEERING CO.

HEAD OFFICE : P.O. BOX 118, BETHANY, OKLAHOMA.

Chairman of the Board of Directors : George T. Pew.

Vice-President, Secretary and Treasurer : Budd Parks.

Vice-President, Director of Sales : R. J. White.

Vice-President, Research and Development : T. R. Smith.

Vice-President, Operations : J. Laister.

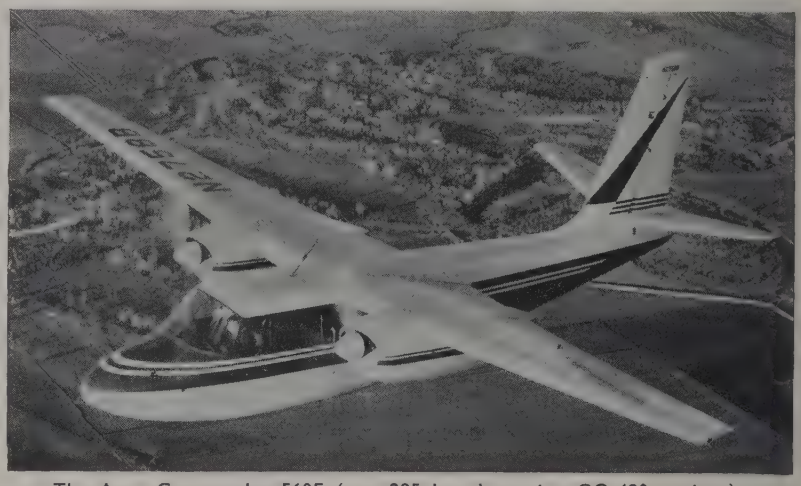
Vice-President, Director of Industrial Relations : H. S. Newman.

Controller : Eugene Burke.

This Company was formed in October, 1950, to manufacture the Aero Commander twin-engined five/seven-seat light transport monoplane. The Aero Commander 520 received its Approved Type Certificate on January 30, 1952, and the first production aircraft was delivered on February 5, 1952. 150 were built before the 520 model was succeeded in production by the 560 model in 1954.

Eighty Aero Commander 560's were produced before this type was superseded by the developed 560A model, of which 102 were built. Concurrently with this version, the Aero Commander 680 Super was put into production in the latter part of 1955 and is still being built, together with a further-improved version of the 560 model known as the 560E. This has a greater wing span than the 560A, which it superseded in production in the spring of 1957.

In January, 1958, the 720 Alti-Cruiser was announced. This is a fully pressurised and air-conditioned development of the 680 Super, and is the first pressurised light twin-engined executive aircraft to be placed on the market.



The Aero Commander 560E (two 295 h.p. Lycoming GO-480 engines).

Another new model is the four-seat Aero Commander 500, which was offered for delivery in the Summer of 1958.

There are now more than 650 Aero Commanders of all types in service all over the world, including the military versions tabulated below.

THE AERO COMMANDER 500.

First offered for delivery in 1958, the Model 500 is a four-seat version of the Aero Commander 560, powered by two 250 h.p. Lycoming O-540 engines. It can be fitted with an 80 U.S. gallon (305 litres) auxiliary fuel tank as an optional extra.

DIMENSIONS.—
As for Model 560E.

WEIGHT.—
Weight loaded 6,000 lb. (2,722 kg.).

PERFORMANCE.—
Cruising speed (70% rated power) 205 m.p.h. (330 km.).
Range with 30 min. fuel reserve 1,100 miles (1,770 km.).

THE AERO COMMANDER 560E.

U.S.A.F. designation: L-26.

In addition to civilian sales of the various versions of the Aero Commander, the U.S.A.F. and U.S. Army have purchased a number of these aircraft, under the following designations :—

YL-26. Three Aero Commander 520's for service trials with U.S. Army.

YL-26A. One Aero Commander 560 for U.S.A.F.

L-26B. Thirteen standard 560A's for U.S.A.F. Used as V.I.P. transports. One for U.S. Army.

L-26C. Aero Commander 680 Super. Two for U.S.A.F. and four for U.S. Army.

RL-26D. New designation of L-26C with special radar.

Two of the U.S.A.F.'s Aero Commanders are reserved for the use of the President and his staff.

On May 28, 1957, a new international Class C.1d distance record of 1,522 miles (2,449 km.) was set up by a 560E piloted by Miss J. Cobb, who flew non-stop from



The Aero Commander L-26B Light Military Transport.

Guatemala City to Oklahoma City in 8 hours 5 minutes.

The following details apply to the current production Aero Commander 560E, of which the prototype flew on December 18, 1956 and the first production model on April 2, 1957.

TYPE.—Twin-engined light transport Monoplane.

WINGS.—Cantilever high-wing monoplane. Wing section NACA 23012 modified. Aspect ratio 9.45. Chord (root) 8 ft. 4 in. (2.54 m.), (tip) 2 ft. 1½ in. (0.65 m.). Dihedral 4°. Incidence 3° at root, −3.5° at tip. All-metal two-spar structure. Hydraulically-operated slotted all-metal flaps between ailerons and fuselage. Total flap area 21.2 sq. ft. (1.97 m.²), total aileron area 20.5 sq. ft. (1.90 m.²). Gross wing area 255 sq. ft. (23.69 m.²).

FUSELAGE.—All-metal semi-monocoque structure with sheet metal covering.

TAIL UNIT.—Cantilever semi-monocoque all-metal structure with metal covering over all surfaces and 10° dihedral on tailplane. Trim-tabs in elevators and rudder. Areas: fin 22.8 sq. ft. (2.12 m.²), rudder 15.4 sq. ft. (1.43 m.²), tailplane 33.06 sq. ft. (3.07 m.²), elevators 20.5 sq. ft. (1.90 m.²). Span of tailplane 16 ft. 8 in. (5.08 m.).

LANDING GEAR.—Retractable tricycle type. Air-oil shock-absorbers. Hydraulic retraction. Goodyear wheels and Goodyear disc-type brakes. Track 12 ft. 11½ in. (3.95 m.). Wheelbase 13 ft. 8 in. (4.16 m.).

POWER PLANT.—Two 295 h.p. Lycoming GO-480-G1B6 six-cylinder horizontally-opposed air-cooled engines. Hartzell three-blade constant-speed full-feathering metal airscrews. Fuel capacity 223 U.S. gallons (843 litres) in bag-type tanks in wings. Oil capacity 8.5 U.S. gallons (31.8 litres).

ACCOMMODATION.—Enclosed cabin of 177 cub. ft. (5 m.³). Standard seating for two in front on individual adjustable seats with dual controls and full-width seat for three at rear of cabin. One or two additional seats may be added at extra cost. Main entry door under wing on port side. Door 20 in. (50.8 cm.) from ground. Cabin heater. All equipment can be removed to permit cabin to be used for freight-carrying, and floor may be reinforced. Optional arrangement provides for both passengers and freight. Baggage compartment aft of cabin with capacity of 34 cub. ft. (0.95 m.³).

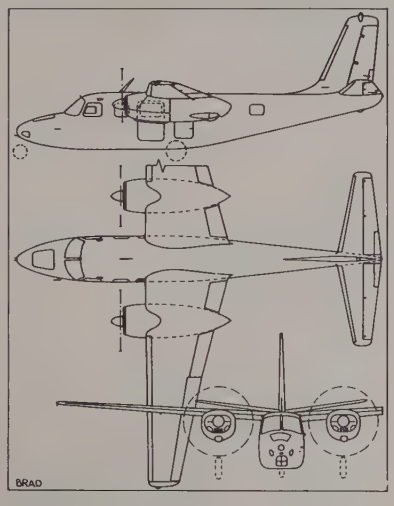
DIMENSIONS.—
Span 49 ft. 0 in. (14.94 m.).
Length 35 ft. 5 in. (10.8 m.).
Height 14 ft. 6 in. (4.42 m.).

WEIGHTS AND LOADINGS.—
Weight empty 4,300 lb. (1,950 kg.).
Weight loaded 6,500 lb. (2,948 kg.).
Wing loading 25.5 lb./sq. ft. (124.5 kg./m².).
Power loading 11.0 lb./h.p. (5.0 kg./h.p.).

PERFORMANCE.—
Max. speed at S/L. 222 m.p.h. (357 km.h.).
Cruising speed (70% rated power) at 10,000 ft. (3,050 m.) 210 m.p.h. (338 km.h.).
Rate of climb at S/L. 1,450 ft./min. (442 m./min.).
Rate of climb at S/L. on one engine 300 ft./min. (90 m./min.).
Service ceiling 22,500 ft. (6,860 m.).
Service ceiling on one engine 8,000 ft. (2,440 m.).



The Aero Commander 680 Super (two 340 h.p. Lycoming GSO-480 engines).



The Aero Commander 680 Super.

Stalling speed at S/L. (flaps at 40°, landing gear down, power off) 66 m.p.h. (106 km.h.).

Take-off distance to clear 50 ft. (15.25 m.), no wind 1,452 ft. (442 m.).

Landing distance from 50 ft. (15.25 m.) 1,500 ft. (460 m.).

Range (at 55% S/L. rated power, 30 min. fuel reserve) at 10,000 ft. (3,050 m.) 1,625 miles (2,615 km.).

THE AERO COMMANDER 680 SUPER.

U.S. Army designation: L-26C.

Announced in September, 1955, this version of the Aero Commander has supercharged engines and is claimed to be the fastest aircraft in production expressly for business use.

An international class height record of 30,330 ft. (9,244.6 m.) was set up by Miss J. Cobb in a standard production 680 Super in August, 1957.

The general description of the Model 560E applies to the 680 Super except for the following:—

POWER PLANT.—Two Lycoming GSO-480-G1A-6 supercharged six-cylinder horizontally-opposed air-cooled engines, each with 340 h.p. available for take-off and 320 h.p. for continuous operation. Fuel capacity 233 U.S. gallons (883 litres).

DIMENSIONS.—
As for Model 560E except:
Span 44 ft. 0¾ in. (13.42 m.).

WEIGHTS AND LOADINGS.—
Weight empty 4,443 lb. (2,017 kg.).
Weight loaded 7,000 lb. (3,175 kg.).
Wing loading 28.9 lb./sq. ft. (141.1 kg./m².).
Power loading 10.3 lb./h.p. (4.67 kg./h.p.).

PERFORMANCE.—
Max. speed at 10,000 ft. (3,050 m.) 260 m.p.h. (418 km.h.).
Cruising speed (70% rated power) at 10,000 ft. (3,050 m.) 230 m.p.h. (370 km.h.).
Cruising speed (65% rated power) at 15,000 ft. (4,570 m.) 230 m.p.h. (370 km.h.).
Stalling speed at S/L. (flaps at 40°, landing gear down, power off) 71 m.p.h. (114 km.h.).
Stalling speed at S/L. (flaps and gear retracted, power off) 79 m.p.h. (127 km.h.).
Rate of climb at S/L 1,625 ft./min. (495 m./min.).
Rate of climb at S/L. on one engine 310 ft./min. (95 m./min.).
Service ceiling 25,567 ft. (7,800 m.).
Service ceiling on one engine 15,000 ft. (4,570 m.).
Range (at 55% S/L. rated power, 30 min. fuel reserve) at 10,000 ft. (3,050 m.) 1,500 miles (2,400 km.).
Range (at most economical cruising speed) 1,600 miles (2,575 km.).
Take-off distance to clear 50 ft. (15.25 m.), no wind 1,265 ft. (386 m.).
Landing distance from 50 ft. (15.25 m.), no wind 1,450 ft. (442 m.).

THE AERO COMMANDER 720 ALTI-CRUISER.

The Alti-Cruiser, announced in January, 1958, is a development of the 680 Super and has the same power-plant. The airframe, however, has been modified for pressurisation.

Pressurisation is provided by a single-stage hydraulically-driven centrifugal compressor supplied by the Stratos Division of the Fairchild Engine and Airplane Corporation. Variable delivery engine-driven hydraulic pumps, one on each engine, provide power to drive the compressor. A cabin pressure control system allows selection of cabin altitudes normally from 5,000 to 7,000 ft. (1,525 to 2,135 m.) below the actual aircraft altitude.

Automatic cabin air-conditioning, both on the ground and in flight, is maintained by a Stratos BUR-20 turbine cooling unit, while heating is provided by a Janitrol 40,000 BThU gasoline heater.

The Alti-Cruiser is available in either a six-seat or a four-seat configuration, the latter with full toilet facilities.

DIMENSIONS, LOADED WEIGHT AND PERFORMANCE.—
Same as for 680 Super.



The Aero Commander 720 Alti-Cruiser (two 340 h.p. Lycoming GSO-480 engines).

AEROCAR

AEROCAR, INC.

HEAD OFFICE AND WORKS: LONGVIEW AIRPORT, WASH.

President and General Manager: Moulton B. Taylor.

Aerocar, Inc. has been developing since February, 1948, a flying automobile designed by Mr. M. B. Taylor. The prototype Aerocar, with a Lycoming O-320 engine, was completed in October, 1949. Well over 100,000 miles of air and ground travel experience have been gained with this prototype and a pre-production Aerocar, which was used for tests which led to C.A.A. Airworthiness Certification of the Aerocar in December, 1956.

Three additional Aerocars have been completed for demonstration tours of the United States. Two of these are fitted with more powerful Lycoming O-340 and Lycoming O-360 engines respectively and are being tested for C.A.A. certification.

Aerocar Inc. are negotiating with various companies to arrange for quantity production of the Aerocar flying automobile. They are also developing a four-seat version known as the Aero-Plane, which will not be roadable. Details of both versions follow.



The Aerocar Model One (143 h.p. (de-rated) Lycoming O-320 engine).

THE AEROCAR MODEL ONE.

The Aerocar is a convertible aeroplane and road vehicle which incorporates a number of features not previously introduced in craft of this type.

The four-wheel automobile section accommodates two seated side-by-side and encloses in the rear portion a 143 h.p. Lycoming engine which provides front-wheel automobile drive and drives a pusher propeller aft of the tail-unit.

The road wheels are driven through a special "fluid drive" system, and the propeller shaft is also driven through a unique new "dry fluid drive" which uses steel shot as the energy transmitting medium. The latter is said to result in smooth and vibration-free operation of the long propeller shaft.

A three-control flight system is combined with the automobile controls, the same wheel being used for both. Conventional clutch and foot brake pedals are provided, together with three forward speeds and reverse in the wheel drive.

The flight section consists of a pair of rigidly-braced wings and a tail section which carries the tail and encloses the drive for the pusher propeller. When the flight section is detached from the body, the wings, which have trailer wheels inset in the leading-edges of the wing roots, may be folded to each side of the tail section and the flight section towed tail first behind the automobile section. The change-over from road transportation to aircraft can be accomplished without special equipment by one person in 5 minutes and all component locks are fool-proof.

DIMENSIONS (Aircraft).—
- Span 34 ft. (10.37 m.).
- Length 21 ft. 6 in. (6.56 m.).
- Height 7 ft. 6 in. (2.29 m.).

DIMENSIONS (Automobile).—
- Length 10 ft. 4 in. (3.15 m.).
- Trailer length 15 ft. (4.57 m.).
- Overall car/trailer length 26 ft. (7.92 m.).
- Height 5 ft. 4 in. (1.62 m.).
- Auto wheel track 5 ft. 2 in. (1.57 m.).
- Auto wheel base 6 ft. 8 in. (2.03 m.).
- Max. width of trailer 8 ft. (2.44 m.).

WEIGHTS AND LOADINGS.—
- Weight empty (auto) 1,012 lb. (460 kg.).
- Weight empty (aircraft) 1,400 lb. (635 kg.).
- Pilot and passenger 340 lb. (154 kg.).
- Fuel and oil 144 lb. (65 kg.).
- Baggage 60 lb. (27 kg.).
- Trailer (wing and tail) 388 lb. (176 kg.).
- Flying weight loaded 2,100 lb. (952.5 kg.).
- Wing loading 10.3 lb./sq. ft. (50.3 kg./m.²).
- Power loading 13.4 lb./h.p. (6.08 kg./h.p.).

PERFORMANCE (Aircraft).—
- Max. permissible speed 139 m.p.h. (224 km.h.).
- Max. level speed at S/L. 110 m.p.h. (176 km.h.).
- Cruising speed (75% power) 100 m.p.h. (160 km.h.).
- Landing speed 50-55 m.p.h. (80-89 km.h.).
- Initial rate of climb 550 ft./min. (168 m./min.).
- Service ceiling 12,000 ft. (3,660 m.).
- Cruising range (43.5 U.S. gallons = 164.3 litres fuel) 500 miles (805 km.).
- Take-off run 650 ft. (200 m.).
- Landing run 300 ft. (91.5 m.).
- Fuel consumption 8 U.S. gallons/hr. (30.3 litres/hr.).

PERFORMANCE (Automobile).—
- Max. road h.p. 40.
- Max. road speed 67 m.p.h. (108 km.h.) at 2,700 r.p.m.
- Practical road cruising speed 55 m.p.h. (88.5 km.h.).
- Practical speed with wings in tow 50 m.p.h. (80 km.h.).
- Road acceleration to 67 m.p.h. (108 km.h.) in 440 yds. (400 m.).
- Road range 300 miles (480 km.).
- Road turning radius 15 ft. (4.57 m.).
- Road fuel consumption 15 miles/U.S. gallon (5.3 km./litre).

THE AEROCAR MODEL II AERO-PLANE.

The Aero-Plane is a non-roadable development of the Aerocar, the two types being identical aft of the rear seat, except that aircraft wheels are fitted on the main landing gear of the Aero-Plane.

Forward of the rear seat, all automobile parts have been deleted, resulting in a weight saving of 360 lb. (163 kg.), and the nose has been lengthened by 15 in. (0.38 m.). Four seats are installed in the re-designed cabin.

The prototype Aero-Plane has been fitted with the wing-tail unit from an existing Aerocar and has a similar Lycoming O-320 engine. As these units have already been approved by the C.A.A., certification of the new aircraft is expected to be obtained comparatively quickly. It was scheduled to fly for the first time in 1958.

AEROPHYSICS

AEROPHYSICS DEVELOPMENT CORPORATION.

ADDRESS: P.O. BOX 689, SANTA BARBARA, CALIFORNIA.

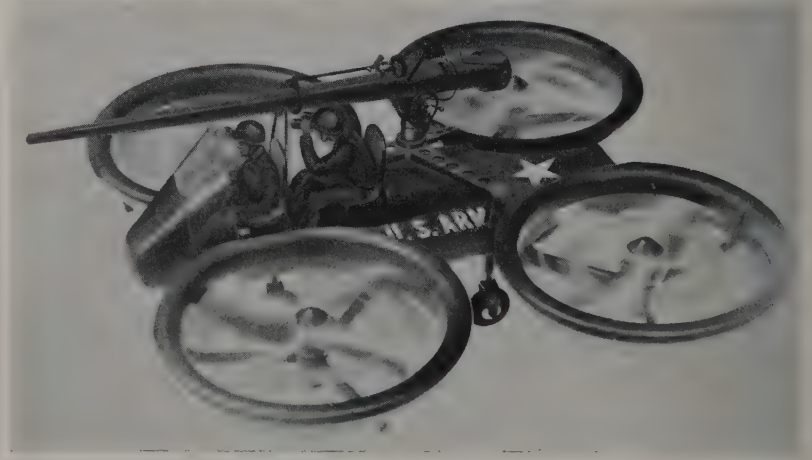
Best-known for its work on missile systems, this company, which is a subsidiary of Curtiss-Wright Corporation, is building a "flying-jeep" type of aircraft under contract from the U.S. Army Transportation and Research Command. The prototype was scheduled to fly late in 1958.

THE AEROPHYSICS AERIAL PLATFORM.

This aircraft was one of three chosen for prototype construction in a U.S. Army design competition for which 21 companies were invited to submit proposals. All three of the winning projects utilise the ducted-fan principle of vertical take-off operation, but the Aerophysics design is the only one having four such fans for maximum stability.

Aerophysics claim that any standard variable-pitch airscrews could be adapted for the rotors of the ducted fans of this aircraft and the prototype is utilising two-blade airscrews produced by the Curtiss-Wright propeller division. They are driven by a Continental-supplied Turbomeca Artouste II shaft-turbine.

The general arrangement of the Aerial Platform can be seen in the accompanying illustration. Dimensions and specification details are not available, but the U.S. Army requirement called for a vehicle weighing 1,000 lb. (455 kg.) and capable of lifting a 1,000 lb. (455 kg.) payload. Air transportability was a further requirement and this is achieved by folding



An artist's impression of the Aerophysics Aerial Platform.

the outer portions of the lift-supplementing shrouds around the fans.

Initially, it is expected that considerable skill will be required to pilot the Aerial Platform; but Aerophysics hope to develop it to the stage where it can be flown by an average soldier, by use of mechanical or electro-mechanical stabilisation devices.

BACON

ERLE L. BACON CORPORATION.

HEAD OFFICE AND WORKS : MUNICIPAL AIRPORT, SANTA MONICA, CALIFORNIA.

President : Erle L. Bacon.

This company has built an extensively-modernised version of the North American T-6 (Navy SNJ) training aircraft, which it has named the Super T-6, primarily for sale to foreign air forces. The prototype began its taxi tests at Santa Monica Airport on December 31, 1956, and flew for the first time in April, 1957.

The company has now taken over the Thermal, California, Airport where shops and hangars are available for the re-manufacture of the Super T-6 on a large scale.



The Bacon Super T-6 (550 h.p. Pratt & Whitney R-1340 engine). (*Warren Bodie*).

THE BACON SUPER T-6.

The Super T-6 is an extensively-modified conversion of the North American T-6 tandem two-seat advanced training aircraft, many thousands of which are in operation throughout the World.

Its principal features include an entirely new tricycle landing gear, a modernised power package with jet stacks and augmentor cooling, and a one-piece streamlined cockpit canopy. The cockpit and instrument panel have been modernised, and the airframe has been cleaned up generally to reduce weight and drag, including a 4 ft. (1.22 m.) reduction in wing span. New lightweight Goodyear wheels with spot-type single-disc brakes and Bendix shock-absorbers are fitted.

Although the original centre-section fuel tanks have had to be deleted to make room for the re-located main landing gear when retracted, the total fuel capacity has been increased slightly by substituting two 50 U.S. gallon (189 litre) wing-tip tanks. Because of this, and the generally-cleaner design, cruising range is increased by approximately 20%. Cruising speed is increased by 45 m.p.h. (72 km.h.).

Optional equipment includes .30 in. machine-gun mountings, bomb racks and rocket launchers.

DIMENSIONS.—
Span 38 ft. 6 in. (11.74 m.).
Length 29 ft. 6 in. (8.99 m.).
Height 11 ft. 8½ in. (3.55 m.).
Wheel track 8 ft. 6 in. (2.59 m.).

PERFORMANCE.—
Max. speed approx. 225 m.p.h. (362 km.h.).
Cruising speed (64% power) 215 m.p.h. (346 km.h.).
Rate of climb at S/L over 1,750 ft./min. (533 m./min.).

BAUMANN

BAUMANN AIRCRAFT CORPORATION.

HEAD OFFICE : P.O. BOX 468, NORTH HOLLYWOOD, CALIFORNIA.

FALCON AIRCRAFT MANUFACTURING COMPANY.

WORKS : P.O. BOX 622, PHOENIX, ARIZONA.

President : P. H. Bruns.

Baumann Aircraft Corporation was formed in 1945 primarily to develop and produce twin-engined all-metal executive transport aircraft. Its first product was the Model B-250 Brigadier, which first flew in June, 1947 and was sold two years later, without the sale of any design rights, to the Piper Aircraft Corporation.

The proceeds of this sale and additional funds, including the profits from sub-contract work, were applied to the engineering and completion of most of the production tooling and part of the construction and certification programme of the first production Model B-290 Brigadier, with more powerful engines than the prototype. This aircraft was described in earlier editions of "All the World's Aircraft."

The B-290 is being modified into the De Luxe Brigadier Model B-360 with two 180 h.p. Lycoming engines, and this improved version will be produced in Baumann's new factory in Arizona, which is operated under the name of the Falcon Aircraft Manufacturing Company.

In addition, the company is building the prototype of the Model B-480 Super Brigadier, with two 240 h.p. Continental engines, and is developing two further aircraft, the 10-seat Baumann Model B-1300 Imperial and a jet-powered version of the Super Brigadier.

THE BAUMANN B-360 DE LUXE BRIGADIER.

TYPE.—Twin-engined five-seat pusher monoplane.

WINGS.—Cantilever shoulder-wing monoplane. All-metal construction. All-metal ailerons. Hydraulically-operated all-metal slotted trailing-edge flaps between nacelles and fuselage. Approximate wing area 209 sq. ft. (19.42 m.²).

FUSELAGE. — All-metal semi-monocoque structure.

TAIL UNIT.—Cantilever monoplane type. All-metal structure. Controllable trim-tabs in rudder and elevators. Tailplane span 13 ft. 2 in. (4.01 m.).

LANDING GEAR.—Retractable tricycle type. Oleo shock-absorbers. Main wheels retract outward into wings. Hydraulic retraction. Goodyear tyres. Hydraulic brakes. Steerable nose-wheel. Track 12 ft. (3.66 m.).

POWER PLANT.—Two 180 h.p. Lycoming horizontally-opposed air-cooled engines mounted as pusher units and driving constant-speed fully-feathering two-blade airscrews. Fuel capacity 76 U.S. gallons (288 litres).

ACCOMMODATION.—Enclosed cabin seating pilot (on port side) and one passenger side-by-side, and with full-width seat for three passengers behind. Access door on port side. Width inside cabin 4 ft. 2 in. (1.27 m.). Height inside cabin 4 ft. 2 in. (1.27 m.). Baggage compartment of 70 cub. ft. (1.98 m.³) capacity aft of rear seat.

DIMENSIONS.—
Span 41 ft. 0 in. (12.49 m.).
Length 28 ft. 5 in. (8.66 m.).
Height 10 ft. 4 in. (3.15 m.).

WEIGHTS.—
Weight empty 2,700 lb. (1,225 kg.).
Weight loaded 4,050 lb. (1,837 kg.).

PERFORMANCE (estimated).—
Max. speed 220 m.p.h. (354 km.h.).
Cruising speed (75% power) 205 m.p.h. (330 km.h.).
Landing speed 63 m.p.h. (101 km.h.).
Rate of climb at S/L. 1,500 ft./min. (457 m./min.).
Rate of climb, one engine out, 500 ft./min. (150 m./min.).
Service ceiling 22,000 ft. (6,700 m.).
Service ceiling, one engine out, 10,000 ft. (3,050 m.).
Range 900 miles (1,450 km.).

THE BAUMANN B-480 SUPER BRIGADIER.

A prototype of the B-480 Super Brigadier is under construction. It will be generally similar to the Model B-360 De Luxe Brigadier, but will have two 240 h.p. Continental O-470-B engines. The fuselage nose forward of the instrument panel and the tail cone fairing will each be 10 in. (0.25 m.) longer than on the Model B-360, and the wing span will be reduced by 5 ft. 4 in. (1.63 m.) by cropping the outer panels.



The Baumann B-360 De Luxe Brigadier (two 180 h.p. Lycoming engines).

BEECHCRAFT

BEECH AIRCRAFT CORPORATION.

HEAD OFFICE AND MAIN WORKS: WICHITA, KANSAS.

BRANCH DIVISIONS: HERINGTON AND LIBERAL, KANSAS, AND BOULDER, COLORADO.

President: Mrs. O. A. (Walter H.) Beech.

Vice-President and General Manager: John P. Gaty.

Vice-President and Co-ordinator: Frank E. Hedrick.

Vice-President—Manufacturing: C. C. Pearson.

Vice-President—Contract Administrator: James N. Lew.

Vice-President — Commercial Sales: Leddy Greever.

Vice-President—Export Sales: M. G. Neuburger.

Vice-President—Military Sales: Lynn D. Richardson.

Secretary and Treasurer: John A. Elliott.

Assistant Treasurer: Lee O. Higdon.

Assistant Secretary: L. Winters.

Founded in 1932 by the late Walter H. Beech, pioneer designer and builder of light aeroplanes in the United States, the Beech Aircraft Corporation is currently engaged in the production of civil and military aircraft, aircraft components, guided missiles, ground power-source support units and aircraft fuel tanks.

Civil aircraft in current production include the four-seat Model J35 Bonanza, the four-seat Model 95 Travel Air, the six-seat Model D50A and Model F50 Twin-Bonanza, and the eight-seat Model E18S Super 18. Military aircraft in production include the L-23D, six-seat version of the Twin-Bonanza produced for the U.S. Army, and the Model 45 Mentor export version of the U.S.A.F. T-34A and U.S. Navy T-34B Mentor trainers. The company has also produced the prototype Model 73 Jet Mentor, a two-seat tandem jet monoplane which is undergoing extensive evaluation tests by the U.S. Armed Services and the R.C.A.F. The rights to build the Jet Mentor in Canada have been acquired by the Canadian Car Company.

Beechcraft are also developing a small executive aircraft designated Model 112, with two Lycoming T53 turboprop engines.

Wholly-owned subsidiaries of the parent company include Beech Research and Development, Inc., which will handle military projects of a classified nature, and Beech Acceptance Corporation (Inc.) which is engaged in financing sales and leasing aircraft to private business firms.

Beech Aircraft's three plants in Wichita, a special engineering facility in Boulder, Colorado, and plants in Herington and Liberal, Kansas, are also engaged in extensive major sub-contract and research work in the development of advanced jet and guided missile products. Current sub-contracts include work on the Lockheed T-33A and F-104, the Republic F-105, the McDonnell F-101A, the Convair F-102 and F-106.



The Beechcraft Model 95 Travel Air (two 180 h.p. Lycoming O-360 engines).

THE BEECHCRAFT MODEL 95 TRAVEL AIR.

Bearing a name that was carried by all the early aircraft designed by the late Walter H. Beech, the Travel Air is a four-seat executive aircraft, of which the prototype made its first flight on August 6, 1956. It received its CAA Type Certificate on June 18, 1957.

TYPE.—Four-seat cabin monoplane.

WINGS.—Low-wing cantilever monoplane. NACA 23000 series wing section. Aspect ratio 7.38. Mean chord 5 ft. 3 in. (1.61 m.). Dihedral 6°. Incidence 4°. Each wing is a two-cell semi-monocoque box beam of aluminium alloy construction. Plain flap-type ailerons of magnesium construction. Single slotted aluminium alloy flaps. Total area of ailerons 11.5 sq. ft. (1.07 m.²). Total area of flaps 21.3 sq. ft. (1.98 m.²). Gross wing area 193.8 sq. ft. (18.00 m.²).

FUSELAGE.— Semi-monocoque aluminium alloy structure.

TAIL UNIT.—Cantilever monoplane type. All-metal structure. Areas: fin 16.67 sq. ft. (1.55 m.²), rudder 6.63 sq. ft. (0.62 m.²), elevators 15.0 sq. ft. (1.39 m.²), tailplane 27.4 sq. ft. (2.54 m.²).

LANDING GEAR.—Retractable tricycle type. Beech air-oil shock absorbers. Electric retraction. Goodyear single-disc hydraulic brakes. Wheel track 9 ft. 7½ in. (2.93 m.) Wheelbase 7 ft. 5¼ in. (2.26 m.).

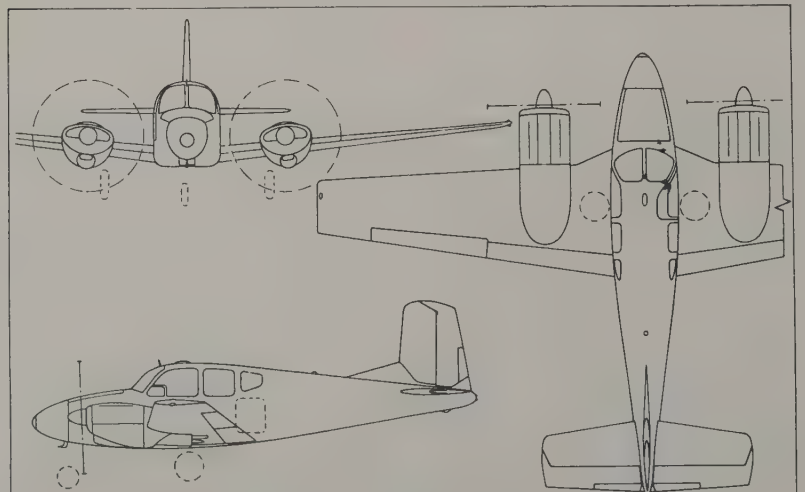
POWER PLANT.—Two Lycoming O-360-A1A four-cylinder horizontally-opposed air-cooled engines, with 180 h.p. available at 2,700 r.p.m. for take-off. Hartzell Type 8447-12 airscrews. Fuel in four wing tanks with total capacity of 112 U.S. gallons (424 litres). Oil capacity 4 U.S. gallons (15 litres).

ACCOMMODATION.—Four-seat enclosed cabin. Two seats side-by-side in front, with orthodox throw-over dual controls, and full-width seat behind. Cabin dimensions 6 ft. 11 in. long × 3 ft. 6 in. wide × 4 ft. 2 in. high (2.11 × 1.07 × 1.27 m.). Access door 3 ft. × 3 ft. 1 in. (0.91 × 0.916 m.) on starboard side. Acrylic moulded windscreen and windows. Middle windows open for ground ventilation, and have release pins to permit their use as emergency exits. Cabin structure reinforced for protection in turn-over.

DIMENSIONS.—
Span 37 ft. 10 in. (11.53 m.).
Length 25 ft. 4 in. (7.72 m.).
Height 10 ft. 1½ in. (3.09 m.).

WEIGHT.—
Weight loaded 4,000 lb. (1,815 kg.).

PERFORMANCE.—
Max. speed at S/L 209 m.p.h. (336 km.h.).
Max. cruising speed at 7,500 ft. (2,290 m.) 200 m.p.h. (322 km.h.).
Landing speed (flaps and wheels down) 70 m.p.h. (113 km.h.).
Rate of climb at S/L 1,360 ft./min. (415 m./min.
Service ceiling 19,300 ft. (5,885 m.).
Take-off run, zero wind 850 ft. (260 m.).
Take-off distance to 50 ft. (15.25 m.), zero wind 1,025 ft. (312 m.).
Max. still air range 1,410 miles (2,270 km.).



The Beechcraft Model 95 Travel Air.

THE BEECHCRAFT MODEL J35 BONANZA.

More than 5,400 Bonanzas have been built for private, executive and feeder-line operation. One of them holds the international Class C-1-c distance record of 4,957.24 miles (7,977.92 km.).

TYPE.—Four-seat Cabin monoplane.

WINGS.—Cantilever low-wing monoplane. Beech modified NACA 23000 series aerofoil section. All-metal structure. Aspect ratio 6.05. Chord 65.33 in. (1.7 m.). Dihedral 6°. Incidence 3°. Each wing panel is a two-cell semi-monocoque box beam of aluminium-alloy construction. Ailerons are made principally of magnesium alloy sheet. NACA single slotted flaps of aluminium alloy. Aileron area 11.5 sq. ft. (1.07 m.²). Flap area 21.3 sq. ft. (1.98 m.²). NACA slotted flaps between ailerons and fuselage. Wing area 177.6 sq. ft. (16.49 m.²).

FUSELAGE. — Semi-monocoque aluminium alloy structure.

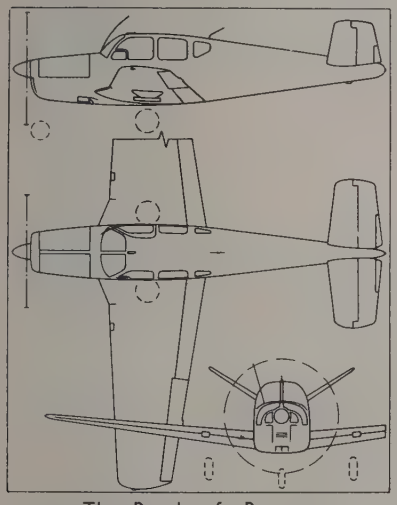
TAIL UNIT.—"Butterfly" type consisting of tailplane and elevators set at acute dihedral angle. Elevators act also as rudders. Semi-monocoque construction with magnesium alloy skin covering on the control surfaces. Fin and tailplane area 23.8 sq. ft. (2.2 m.²). Rudder and elevator area 12.0 sq. ft. (1.11 m.²). Tailplane span 10 ft. 1⅝ in. (3.08 m.).

LANDING GEAR.—Retractable tricycle type. Beech air-oil shock struts. Electric retraction. Single-disc hydraulic brakes. Wheelbase 7 ft. 5¼ in. (2.28 m.). Track 9 ft. 7½ in. (2.93 m.).

POWER PLANT.—One Continental IO-470-C engine rated at 250 h.p. at 2,660 r.p.m. for take-off. Beech Series 278 aluminium-alloy blade hydraulically-controlled continuously variable pitch airscrew 6 ft. 10 in. (2.08 m.) diameter, with Woodward hydraulic governor and Beech spinner. Two standard wing tanks, 39 U.S. gallons (148 litres) useable. Two auxiliary wing



The Beechcraft Model J35 Bonanza (250 h.p. Continental 10-470 engine).



The Beechcraft Bonanza.

tanks, 18 gallons (68 litres) useable. Oil capacity 2¼ U.S. gallons (8.5 litres).

ACCOMMODATION.—Four-seat enclosed cabin. Two seats side-by-side in front, with orthodox throw-over dual controls, and full-width seat behind. Cabin dimensions 6 ft. 11 in. long × 3 ft. 6 in. wide × 4 ft. 2 in. high (2.11 × 1.07 × 1.27 m.). Access door 3 ft. × 3 ft. 1 in. (0.91 × 0.916 m.) on starboard side. Acrylic moulded windscreen and windows. Middle windows open for ground ventilation, and have release pins to permit their use as emergency exits. Cabin structure reinforced for protection in turn-over. Baggage compartment with capacity of 16.5 cub. ft. (0.47 m.³) and allowance of 270 lb. (122.5 kg.) aft of seats. Baggage access door 2 ft. × 1 ft. 10 in. (0.61 × 0.56 m.) on starboard side of fuselage.

DIMENSIONS.—
Span 32 ft. 10 in. (10 m.).
Length 25 ft. 2 in. (7.67 m.).
Height 6 ft. 6¼ in. (2 m.).

WEIGHTS AND LOADINGS.—
Weight empty (fully equipped) 1,820 lb. (826 kg.).
Useful load 1,080 lb. (490 kg.).
Payload with max. fuel 830 lb. (377 kg.).
Weight loaded 2,900 lb. (1,315 kg.).
Wing loading (fully loaded) 16.3 lb./sq. ft. (79.6 kg./m.²).
Power loading (fully loaded) 11.6 lb./h.p. (5.26 kg./h.p.).

PERFORMANCE.—
Max. speed 210 m.p.h. (338 km.h.) at sea level.
Max. cruising speed (75% power) 200 m.p.h. (322 km.h.) at 7,000 ft. (2,135 m.).
Econ. cruising speed (65% power) 195 m.p.h. (314 km.h.) at 10,000 ft. (3,050 m.).
Stalling speed, with flaps 57 m.p.h. (91.7 km.h.).
Rate of climb at sea level 1,250 ft./min. (380 m./min.).
Service ceiling 21,300 ft. (6,490 m.).
Max. range at 180 m.p.h. (290 km.h.) at 10,000 ft. (3,050 m.) 725 miles (1,168 km.) on 39 gallons (147.8 litres,) 1,060 miles (1,706 km.) on 57 gallons (216 litres).
Take-off run in 10 m.p.h. (16 km.h.) wind at sea level (20° flaps) 670 ft. (205 m.).
Landing run in 10 m.p.h. (16 km.h.) wind at sea level (30° flaps) 400 ft. (122 m.).
Fuel economy at max. range 18.6 miles per U.S. gallon (7.9 km. per litre).

THE BEECHCRAFT MODEL 45 MENTOR.

U.S.A.F. designation : T-34A.
U.S. Navy designation: T-34B.

The Beechcraft Mentor is basically a military trainer adaptation of the Bonanza. It is standard equipment in the U.S. Air Force, U.S. Navy and the air forces of eight other nations, and is being manufactured under licence by Fuji Heavy Industries of Tokyo, Japan, and by the Argentine Republic.

Two versions have been built, as follows :—

T-34A. For U.S.A.F. More than 300 built. Prototype flew on December 2, 1948.

T-34B. For U.S. Navy, with additional equipment. Production completed in October 1957, after 423 built.

Argentine T-34 production will continue into 1959. This involved the supply of 15 complete aircraft, followed by the dis-assembled components for approximately 75 more, to be assembled in the Argentine government factory at Cordoba. All of these aircraft will carry the optional armament for weapons training.

TYPE.—Two-seat Primary Trainer.

WINGS.—Low-wing cantilever monoplane. Same type structure as for the Bonanza, but with incidence of 4°. Wing area 177.6 sq. ft. (16.49 m.²).

FUSELAGE.—Metal structure with flush-riveted metal skin.

TAIL UNIT.—Conventional cantilever monoplane type. All-metal structure of magnesium. Adjustable trim-tabs in elevators and rudder. Areas : fin 10.39 sq. ft. (.97 m.²), rudder 6.63 sq. ft. (.61 m.²), elevators 15 sq. ft. (1.39 m.²), tailplane 37.25 sq. ft. (3.46 m.²). Tailplane span 12 ft. 2⅛ in. (3.71 m.).

LANDING GEAR.—Retractable tricycle type. Same as for Bonanza. Electric retraction with emergency hand control. Beech air-oil struts on all wheels. Split-type wheels with single disc hydraulic brakes. Wheel track 9 ft. 8⅔ in. (2.94 m.). Wheelbase 7 ft. 5½ in. (2.28 m.).

POWER PLANT.—One 225 h.p. Continental O-470-13 six-cylinder horizontally-opposed air-cooled engine. Beech Model 278-101 all-metal constant-speed airscrew 7 ft. (2.13 m.) in diameter. Two wing fuel tanks, Capacity 50 U.S. gallons (225 litres). Oil capacity 3 U.S. gallons (11.35 litres). Entire power-plant assembly including engine, airscrew, accessories and oil system, may be changed as a unit.

ACCOMMODATION.—Tandem cockpits under continuous transparent canopy with sections over each seat which may be independently opened or latched in intermediate positions. Conventional three-control system duplicated in each cockpit. Adjustable seats in both cockpits. Heating and ventilation. Windshield de-froster. VHF radio receiver and transmitter. Baggage compartment aft of rear cockpit.

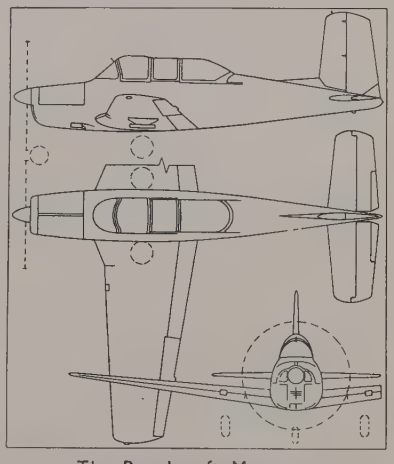
ARMAMENT (optional).—One machine-gun or camera gun in each wing. Bomb racks or rocket rails under wings.

DIMENSIONS.—
Span 32 ft. 10 in. (10 m.).
Length 25 ft. 11 in. (7.9 m.).
Height (over tail) 10 ft. 0¼ in. (3.04 m.).

WEIGHTS AND LOADINGS (T-34A).—
Weight empty 2,156 lb. (978 kg.).
Weight loaded 2,950 lb. (1,338 kg.).
Wing loading 16.3 lb./sq. ft. (79.54 kg./m.²).
Power loading 12.9 lb./h.p. (5.85 kg./h.p.).

WEIGHTS AND LOADINGS (T-34B).—
Weight empty 2,254 lb. (1,022 kg.).
Weight loaded 2,985 lb. (1,354 kg.).
Wing loading 16.75 lb./sq. ft. (81.78 kg./m.²).
Power loading 13.2 lb./h.p. (5.99 kg./h.p.).

PERFORMANCE (T-34A).—
Max. speed at S/L. 189 m.p.h. (304 km.h.).
Max. cruising speed 173 m.p.h. (277 km.h.) at 10,000 ft. (3,050 m.).



The Beechcraft Mentor.



The Beechcraft Model 45 Mentor (225 h.p. Continental O-470 engine).

Stalling speed (flaps down) 54 m.p.h. (87 km.h.).
Rate of climb at S/L. 1,230 ft./min. (375 m./min.).
Service ceiling 20,000 ft. (6,100 m.).
Max. cruising range 737 miles (1,186 km.).
Take-off to 50 ft. (15.25 m.) no wind (10° flaps) 1,200 ft. (366 m.).
Landing run from 50 ft. (15.25 m.) no wind (full flaps) 960 ft. (293 m.).

PERFORMANCE (T-34B).—
Max. speed 188 m.p.h. (302 km.h.).
Cruising speed 170 m.p.h. (274 km.h.).
Stalling speed (flaps down) 54 m.p.h. (87 km.h.).
Rate of climb at S/L. 1,160 ft./min. (354 m./min.).
Service ceiling 19,500 ft. (5,945 m.).
Range with max. payload 728 miles (1,171 km.).

THE BEECHCRAFT MODEL 73 JET MENTOR.

The Jet Mentor is a low-cost, economical, high-performance jet trainer, based on the T-34 Mentor and using many of the same components. Built as a private venture, to meet military specifications, it is America's first light single-engined jet aircraft. The prototype made its first flight on December 18, 1955.

TYPE.—Light two-seat Jet Trainer.

WINGS.—Low-wing cantilever monoplane, basically the same as for the T-34 Mentor. Aspect ratio 6.05. Chord 65.33 in. (1.7 m.). Dihedral 7°. Incidence 4°. Simple flap-type ailerons. Single slotted flaps. Aileron area 11.5 sq. ft. (1.07 m.²). Flap area 21.3 sq. ft. (1.98 m.²). Speed brake area 3.12 sq. ft. (0.29 m.²). Wing area 177.6 sq. ft. (16.49 m.²).

FUSELAGE. — All metal semi-monocoque structure, with bulkheads, centre-section spars, stringers and skin of aluminium alloy.

TAIL UNIT.—Conventional all-metal cantilever monoplane type. Areas: fin 12.4 sq. ft. (1.15 m.²), rudder 7.0 sq. ft. (0.65 m.²), elevators 14.34 sq. ft. (1.33 m.²), tailplane 26.96 sq. ft. (2.50 m.²). Tailplane span 12 ft. 10⅛ in. (3.9 m.).

LANDING GEAR.—Retractable tricycle type. Beech air-oil struts. Electric retraction. Single disc hydraulic brakes. Wheel track 9 ft. 8½ in. (2.96 m.). Wheelbase 12 ft. 5½ in. (3.79 m.).

POWER PLANT.—One Continental J69-T-9 turbojet engine (920 lb.=417 kg. s.t.). Two wing fuel tanks with total capacity of 180 U.S. gallons (681 litres).

ACCOMMODATION.—Tandem seats under a power-operated clamshell-type jettisonable canopy. Dual instrumentation, cockpit air conditioning and ejection seats optional.

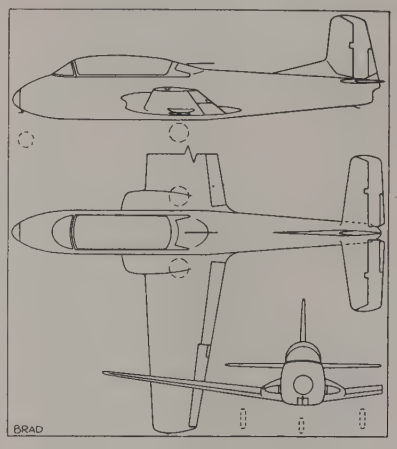
DIMENSIONS.—
Span 32 ft. 9 in. (9.98 m.).
Length 31 ft. 9½ in. (9.68 m.).
Height 9 ft. 10½ in. (3.02 m.).

WEIGHTS.—
Weight empty 2,854 lb. (1,295 kg.).
Useful load 1,596 lb. (724 kg.).
Weight loaded 4,450 lb. (2,018 kg.).

PERFORMANCE.—
Max. speed 288 m.p.h. (463 km.h.).
Cruising speed 250 m.p.h. (402 km.h.).
Diving speed 500 m.p.h. (805 km.h.).
Stalling speed at landing weight 70 m.p.h. (112 km.h.).
Service ceiling 26,600 ft. (8,105 m.).
Rate of climb at S/L. 1,440 ft./min. (440 m./min.).
Max. range with no fuel reserve, 500 miles (805 km.).
Max. endurance 2.3 hours.



The Beechcraft Jet Mentor (Continental J69 turbojet engine).



The Beechcraft Jet Mentor.

THE BEECHCRAFT MODEL D50A TWIN-BONANZA.

U.S. Army designation: L-23E Seminole.

First of the American light twin-engined aircraft of post-war design, the prototype Twin-Bonanza flew on November 15, 1949. A number of Model D50 Twin-Bonanzas have been acquired by the U.S. Army Field Forces, under the designation L-23E. Earlier versions, still in service with the U.S. Army, have been described in previous editions of "All the World's Aircraft."

The following description applies to the standard commercial version of the D50A.

TYPE.—Twin-engined six/seven-seat Cabin monoplane.

WINGS.—Low-wing cantilever monoplane. Wing section NACA 23014.1 at root, NACA 23012 at tips. Aspect ratio 7.51. Chord 78.15 in. (1.99 m.). Dihedral 7°. Incidence 5.8° at root, 1° at tip. All-metal two-cell, semi-monocoque box beam structure. Single slotted flaps and simple flap-type ailerons of magnesium sheet. Areas: flaps 37.8 sq. ft. (3.51 m.²), ailerons 13.89 sq. ft. (1.29 m.²). Gross wing area 277 sq. ft. (25.83 m.²).

FUSELAGE. — Conventional semi-monocoque metal structure with flush-riveted aluminium alloy skin.

TAIL UNIT.—Cantilever monoplane type. Slight dihedral to tailplane. All-metal structure. Tailplane and fin are of aluminium alloy. Rudder and elevator are covered in magnesium sheet. Areas: fin 14.25 sq. ft. (1.32 m.²), rudder 12.77 sq. ft. (1.18 m.²), tailplane 47.25 sq. ft. (4.39 m.²), elevators 17.49 sq. ft. (1.62 m.²). Tailplane span 16 ft. 4 in. (4.98 m.).

LANDING GEAR.—Retractable tricycle type. Electric actuation. Main shock-strut assemblies interchangeable on either side. Split type wheels. Single-disc hydraulic brakes. Nose wheel is steerable. Main wheel track 12 ft. 9 in. (3.88 m.). Wheelbase 10 ft. 9 in. (3.28 m.).

POWER PLANT.—Two Lycoming GO-480-G2D6 six-cylinder horizontally-opposed air-cooled engines, with 295 h.p. at 3,400 r.p.m. available at take-off and normal rating of 285 h.p. at 3,100 r.p.m. at S/L. Hartzell three-blade aluminium alloy, fully-feathering, constant-speed, hydraulically-controlled airscrews. Fuel capacity 180 U.S. gallons (681 litres) in two 44 gallon (166 litres) inboard wing tanks, two 23 gallon (87 litres) outboard wing tanks and two optional 23 gallon (87 litre) auxiliary wing tanks. Oil capacity 6 U.S. gallons (22.7 litres).

ACCOMMODATION.—Enclosed cabin seating a maximum of six; pilot, co-pilot and passenger on front seat 54 in. (1.37 m.) wide and three passengers on rear seat 52 in. (1.32 m.) wide. Optional five-seater has only two front seats, on a lateral track for right side or centre aisle. Two baggage compartments, one forward and one aft. A stretcher patient can be loaded through rear baggage door without need to climb on wing. Capacity of front baggage compartment 14 cub. ft. (0.4 m.³), rear compartment 41 cub. ft. (1.16 m.³). Equipment includes cabin sound-proofing, heating and ventilation, and choice of radio installations.

DIMENSIONS.—
Span 45 ft. 3⅜ in. (13.81 m.).
Length 31 ft. 6½ in. (9.61 m.).
Height 11 ft. 4 in. (3.46 m.).

WEIGHTS AND LOADINGS.—
Weight empty 4,090 lb. (1,855 kg.).
Weight loaded 6,300 lb. (2,858 kg.).
Wing loading 22.74 lb./sq. ft. (111.0 kg./m.²).
Power loading 11.05 lb./h.p. (5.01 kg./h.p.).

PERFORMANCE.—
Max. speed at 2,500 ft. (760 m.) 214 m.p.h. (344 km.h.).
Cruising speed (70%) power at 7,000 ft. (2,135 m.) 203 m.p.h. (327 km.h.).
Landing speed (full flaps) 71 m.p.h. (114 km.h.).
Rate of climb at S/L. 1,450 ft./min. (442 m./min.).
Single-engine climb at S/L. 300 ft./min. (91 m./min.).



The Beechcraft Model F50 Twin-Bonanza (two 340 h.p. Lycoming GSO-480 engines).

Service ceiling 20,000 ft. (6,100 m.).
Single-engine ceiling 7,000 ft. (2,135 m.).
Max. range (at 160 m.p.h., no reserve) at 10,000 ft. (3,050 m.) 1,650 miles (2,655 km.).
Take-off to 50 ft. (15.25 m.) S/L. and no wind 420 yds. (385 m.).
Landing over 50 ft. (15.25 m.) no wind 484 yds. (442 m.).

THE BEECHCRAFT MODEL F50 TWIN-BONANZA.

U.S. Army designation: L-23D Seminole.

The Model F50 Twin-Bonanza and the equivalent U.S. Army version, the L-23D, have two Lycoming GSO-480-B1B6 supercharged engines for improved performance.

Otherwise the general structural description of the civil Model D50A Twin-Bonanza previously described applies to this aircraft.

Power Plant.—Two Lycoming GSO-480-B1B6 geared supercharged six-cylinder horizontally-opposed air-cooled engines with 340 h.p. at 3,400 r.p.m. available at take-off and normal rating of 320 h.p. at 3,200 r.p.m. at S/L. Fuel capacity 230 U.S. gallons (872 litres) in two 44 gallon (166 litre) inboard wing tanks, two 46 gallon (174 litre) outboard wing tanks and two optional 25 gallon (96 litre) auxiliary wing tanks. Oil capacity 8 U.S. gallons (30.25 litres).



The Beechcraft L-23D Seminole, the U.S. Army version of the F50 Twin-Bonanza.

Fuselage. — All-metal semi-monocoque structure with 24S-T aluminium-alloy frames, extruded stringers and skin.

Tail Unit.—Conventional cantilever monoplane type with twin fins and rudders. Tailplane and fin of aluminium-alloy. Elevators and rudders have aluminium-alloy frames and are fabric covered. Areas: fins 20.08 sq. ft. (1.86 m.²), rudders 13.5 sq. ft. (1.25 m.²), elevators 22 sq. ft. (2.04 m.²), tailplane 49.58 sq. ft. (4.61 m.²). Tailplane span 14 ft. 11½ in. (4.56 m.).



The Beechcraft Super 18 (two 450 h.p. Pratt & Whitney R-985 engines).

Dimensions.—
As for Model D50.
Weights and Loadings.—
Weight empty 4,460 lb. (2,023 kg.).
Weight loaded 7,000 lb. (3,175 kg.).
Wing loading 25.2 lb./sq. ft. (123.03 kg./m.²).
Power loading 10.9 lb./h.p. (4.94 kg./h.p.).
Performance.—
Max. speed at 9,000 ft. (2,750 m.) 240 m.p.h. (386 km.h.).
Cruising speed (70% power) at 13,300 ft. (4,050 m.) 228 m.p.h. (367 km.h.).
Landing speed (full flaps) 80 m.p.h. (129 km.h.).
Rate of climb at S/L. 1,620 ft./min. (495 m./min.).
Single-engine climb at S/L. (at 6,000 lb.= 2,722 kg. A.U.W.) 445 ft./min. (136 m./min.).
Service ceiling 24,800 ft. (7,560 m.).
Single-engine ceiling (at 6,000 lb.= 2,722 kg. A.U.W.) 15,500 ft. (4,730 m.).
Max. range at 169 m.p.h. (272 km.h.) no reserve at 10,000 ft. (3,050 m.) 1,650 miles (2,655 km.).
Take-off to 50 ft. (15.25 m.) at S/L. no wind 417 yds. (381 m.).
Landing from 50 ft. (15.25 m.), no wind 613 yds. (560 m.).

THE BEECHCRAFT SUPER 18.

Type.—Twin-engined light Transport.

Wings.—Low-wing cantilever monoplane. Wing section modified NACA 23000 series. Aspect ratio 6.85. Chord 96.64 in. (2.45 m.). Dihedral 6°. Incidence 3.92°. All-metal two-spar structure, with the inboard half of the main spar built as a steel alloy truss. Ailerons are fabric-covered with aluminium-alloy frames. Flaps are of all-metal construction. Aileron area 17.48 sq. ft. (1.62 m.²). Flap area 28.12 sq. ft. (2.61 m.²). Gross wing area 361 sq. ft. (33.54 m.²).

Landing Gear.—Tailwheel type. Geisse safety gear for cross-wind landings is optional equipment. Beech air-oil struts. Electric retraction. Integral single-disc brakes with controls for both pilot and co-pilot. Wheel track 12 ft. 11 in. (3.93 m.). Wheelbase 23 ft. 2 in. (7.06 m.).

Power Plant.—Two 450 h.p. Pratt & Whitney R-985-AN14B radial air-cooled engines. Hamilton Standard Hydromatic fully-feathering airscrews. Normal tankage comprises four wing tanks with a total capacity of 198 U.S. gallons (750 litres), and a nose tank with a capacity of 77 U.S. gallons (291 litres). Auxiliary wing tanks bring total available tankage to 318 U.S. gallons (1,205 litres).

Accommodation.—Pilot's compartment in nose, seating two side-by-side. Passenger cabin is separated from pilot's compartment by folding door and seats 5-7 passengers. Separate toilet-baggage compartment aft of cabin. Built-in entrance steps, reclining seats, individual lighting and ventilation controls. Sound-proofing, controlled ventilation and heating. Refreshment bar and fold-away card tables optional.

Dimensions.—
Span 49 ft. 8 in. (15.14 m.).
Length 35 ft. 2⅛ in. (10.70 m.).
Height 9 ft. 6 in. (2.90 m.).
Weights and Loadings.—
Weight empty (equipped) 6,050 lb. (2,744 kg.).
Disposable load 3,250 lb. (1,474 kg.).
Weight loaded 9,300 lb. (4,218 kg.).
Wing loading 25.75 lb./sq. ft. (135.66 kg/m.²).
Power loading 10.32 lb./h.p. (4.68 kg./h.p.).
Performance.—
Max. speed 234 m.p.h. (374 km.h.) at 3,300 ft. (1,512 m.).
Cruising speed (66.7% METO) 207 m.p.h. (331 km.h.) at 5,000 ft. (1,525 m.), 215 m.p.h. (344 km.h.) at 10,000 ft. (3,050 m.).
Max. rate of climb at S/L. (8,750 lb.= 3,970 kg. A.U.W.) 1,490 ft./min. (450 m./min.).
Service ceiling 23,300 ft. (7,106 m.).
Service ceiling on one engine (at 8,750 lb.= 3,970 kg. weight) 10,350 ft. (3,155 m.).
Range (200 h.p. at 10,000 ft.=3,050 m.) 1,626 miles (2,616 km.).
Take-off distance to 50 ft. (15.25 m.) at S/L. 600 yds. (549 m.).
Landing distance from 50 ft. (15.25 m.) at S/L. 566 yds. (418 m.).

THE BEECHCRAFT MODEL 1001 TARGET.

U.S. Navy designation: XKDB-1.

The XKDB-1 pilotless remotely-controlled target aircraft, which won a U.S. Navy design competition in 1955, is the first product of Beech's guided-missile division. Powered by a 120 h.p. McCulloch six-cylinder opposed two-stroke turbo-supercharged air-cooled engine, it



The Beechcraft XKDB-1 Target Drone (120 h.p. McCulloch engine).

is an all-metal high-wing monoplane with vee-tail, and is intended as an "out-of-sight" target for surface-to-air and air-to-air gunnery practice.

The XKDB-1 is designed for catapult-launching ashore and afloat, or for zero-length launching. It has a recovery parachute and a foam-filled structure for flotation.

The U.S. Navy has placed two orders for substantial test quantities of XKDB-1's, which are being built at Wichita. The first free flights were made at the U.S.N. Air Missile Test Center, Point Mugu, Calif., in the Spring of 1957.

DIMENSIONS.—
Span 12 ft. 6 in. (3.81 m.).
Length 13 ft. 6 in. (4.12 m.).
WEIGHT.—
Weight loaded 600 lb. (272 kg.).
PERFORMANCE.—
Max. speed over 320 m.p.h. (515 km.h.).
Service ceiling over 40,000 ft. (12,190 m.).
Endurance at altitude over one hour.

THE BEECHCRAFT MODEL 1013.

This pilotless aircraft is designed for photographic and television reconnaissance duties, carrying multiple cameras for battle-field surveillance by day and night, under remote radio control. Externally, it is almost identical to the Model 1001 target drone, from which it has been developed, but is powered by a 110 h.p. six-cylinder McCulloch engine. It has the alternative capability of delivering tactical supplies to isolated combat units.

DIMENSIONS.—
As for Model 1001.
WEIGHT.—
Weight loaded 800 lb. (363 kg.).
PERFORMANCE.—
Operational speed 260 m.p.h. (418 km.h.).
Service ceiling 22,800 ft. (6,950 m.).
Endurance 75 min.

BELL

BELL AIRCRAFT CORPORATION.

HEAD OFFICE: P.O. Box 1, BUFFALO 5, N.Y.

President and General Manager: Leston P. Faneuf.

First Vice-President and General Manager of the Niagara Frontier Division: Ray P. Whitman.

Vice-President and Manager of Aircraft Division: Julius J. Domonkos.

Vice-President: Roy J. Sandstrom.

Vice-President and Treasurer: William G. Gisel.

Bell Aircraft Corpn. was formed in 1935 by Lawrence D. Bell, formerly Vice-President and General Manager of the Consolidated Aircraft Corpn., R. P. Whitman, who was Assistant General Manager of Consolidated, and the late Robert J. Woods, Consolidated's Chief Engineer. When Consolidated moved its factory from Buffalo to San Diego, Cal., these three men remained in Buffalo to form the new company, of which Lawrence Bell was still Chairman at the time of his death on October 20, 1956.

By that year, the company's helicopter activities had become so extensive that on January 1, 1957, its Helicopter Division at Fort Worth, Texas, was given full corporate status, becoming the Bell Helicopter Corporation. The current products of this Corporation are described separately after those of the parent company.

A further reorganisation took place in February, 1958, when it was announced that all defense products activities of the Bell Aircraft Corporation's Buffalo and Niagara Frontier plants would be operated thereafter by a newly-established autonomous unit known as the Niagara Frontier Division. At the same time, Vice-President R. J. Sandstrom was assigned to plan and direct the company's projects and activities in the satellite and space travel categories.

These include a study of the problems associated with a long-range high-altitude aircraft employing the hypersonic glider principle. Bell initiated this study as a private venture in 1951, and has continued it under U.S.A.F. contract for the past four years. A hypersonic glider of the type envisaged would be boosted to high altitude by rocket propulsion and would complete its mission in a glide, after which the pilot would return to make a normal landing at his base airfield.

Bell Aircraft also continues to contribute to the U.S. high-speed flight research programme. Its Rockets Division has designed and manufactured ballistic control rockets for installation on the Bell X-1E research aircraft, which is being flight tested by the N.A.C.A. Similar rocket controls will be provided for the North American X-15 hypersonic research aircraft, to ensure adequate control at extreme altitudes.

It was announced officially in 1958 that the Bell X-2 research aircraft attained a speed of 2,148 m.p.h. (3,457 km.h.), equivalent to Mach 3.25, and an altitude of 126,200 ft. (38,465 m.) or just under 24 miles, before it was destroyed in an accident on September 27, 1956. These performances still stood as unofficial records for a manned aircraft at the time of writing. Full details of the Bell X-1, X-2 and X-5 series of research aircraft have appeared in earlier editions of "All the World's Aircraft."

Bell claims to be the only company in the United States which is manufacturing and investigating four concepts of vertical take-off aircraft. These are the helicopter, the tilting-rotor convertiplane, the jet-powered VTOL and the ducted-airscrew VTOL.

Bell has a U.S.A.F. contract to develop the X-14, which uses the jet deflection technique. In addition, the company's Aircraft Division has initiated work on the design of an advanced operational jet-powered vertical-rising aircraft for the U.S. Navy, embodying the concept pioneered in 1954 with its small jet-powered VTOL research aircraft.

The ducted-airscrew concept, although generally similar to the jet VTOL has turboprop engines to provide the thrust to lift the aircraft vertically and propel it forward. The airscrews are surrounded by cowlings or ducts and, as in the VTOL, the complete power plants are rotated for transition from vertical to horizontal flight. Military applications of this configuration are being studied.

Details of some of the company's guided missile and rocket propulsion activities are given in the "Guided Missiles" section of this work.

In the rocket propulsion field Bell has completed delivery of booster motors for the Douglas Nike missile, but is continuing the production of three-chamber engines for the company's own GAM-63 Rascal air-to-surface guided missile.

An engine which Bell designed and produced originally for an air-to-surface missile, which was to have been carried by the B-58 Hustler bomber, is now being used in modified form for second-stage propulsion of a classified satellite programme.

Under active development is the Bell Automatic All-Weather Airplane Landing System, which was initiated under a U.S. Navy Bureau of Ships contract and is now the subject of both Navy and U.S.A.F. contracts. Combining radio and radar equipment with an electronic computer, it had been used for more than 2,000 completely automatic landings in all weather conditions by jet fighters, large transport aircraft and lightplanes at a number of airfields before its shipboard trials in 1957. In the latter, more than 100 fully-automatic landings were made by a Douglas F3D jet fighter equipped with the System.

Although developed originally for carrier-based aircraft, the Automatic All-Weather Airplane Landing System has much wider potential applications. Delivery of the U.S.A.F. version is scheduled for early 1959, and it is being evaluated for landing test versions of the Chance Vought Regulus II missile. It could also be linked with a standard navigational system to make possible completely automatic flight by military and commercial aircraft under all weather conditions.

Bell is engaged on extensive sub-contract work, with contracts for Boeing B-52 engine nacelles and Douglas B-66 tail-cones and electronic equipment platforms extending into 1959. It has also delivered modified B-47 engine nacelles to Hayes Aircraft Corporation for installation on KB-50 flight refuelling tankers, to provide added power for take-off and increased speed for jet refuelling operations.

Employment totalled 13,404 persons at the end of 1957, with 10,095 in the Aircraft, Avionics, Rocket and Special Weapons Divisions and 3,309 in the Bell Helicopter Corporation at Fort Worth, Texas.

THE BELL X-14.

The X-14 is an experimental vertical take-off aircraft of extremely simple design, which has been built under U.S.A.F. contract.

The X-14 is an open-cockpit mid-wing monoplane of all-metal construction and is powered by two Armstrong Siddeley Viper turbojets mounted horizontally side-by-side in the fuselage nose. Thrust diverters are mounted behind the engines to deflect the jet efflux towards the ground during take-off and landing. In this way, the X-14 is able to raise itself vertically off the ground by direct



The Bell X-14 Experimental VTOL Monoplane (two Armstrong Siddeley Viper turbojets).

jet lift, with its fuselage in the horizontal position.

At a safe height, the jet efflux is deflected slightly rearward, to produce forward thrust in addition to jet lift. When the forward speed is sufficient for the fixed wings to provide adequate lift, the efflux is re-directed towards the rear and the aircraft flies in a conventional manner. For vertical landing the pilot reverses the take-off technique.

During take-off, landing, hovering and flight at slow speeds, directional control is effected by means of compressed air nozzles at the wing-tips and tail.

First hovering flight of the X-14 was made on February 19, 1957 and it made a successful transition from hovering to forward flight on May 24, 1958. It has attained a forward speed of 160 m.p.h. (257 km.h.).

DIMENSIONS.—
Span 34 ft. (10.36 m.).
Length 25 ft. (7.62 m.).
Height 8 ft. (2.44 m.).

BELL HELICOPTER CORPORATION.

HEAD OFFICE: P.O. Box 482, FORT WORTH, TEXAS.

President: Harvey Gaylord.

Vice-President and Contracts Director: G. B. Clark.

Vice-President and Manufacturing Manager: Roy Coleman.

Vice-President: E. J. Ducayet.

Vice-President and Secretary: W. G. Gisel.

Vice-President and Chief Helicopter Engineer: Bart Kelley.

Treasurer: J. F. Atkins.

Formerly the Helicopter Division of Bell Aircraft Corpn., the Bell Helicopter Corpn. became a separate wholly-owned subsidiary of that company on January 1, 1957 and is responsible for all Bell activities in the rotating wing field.

Bell was early in the field in helicopter development. Following two years' development work, an experimental Model 30 was flying in 1943, and this craft was superseded late in 1945 by the first of the Model 47 Series. This helicopter received the first helicopter Approved Type Certificate from the C.A.A. on March 8, 1946, since when the Model 47 has been in continuous production in both military and commercial forms.

Present production at Fort Worth is concerned mainly with new models of the Bell 47 and experimental and development work with various craft of advanced design. These include the HU-1A turbine-powered helicopter and the XV-3 experimental convertiplane. In addition, the company has been awarded U.S. Army design study contracts for a lightweight two-seat observation helicopter and a large "flying crane" helicopter capable of lifting loads of up to 16 tons.

Since the delivery of the first commercial Model 47 in December, 1946, well over 2,000 Bell helicopters have been bought by the U.S. armed forces and by commercial operators in the United States and abroad.



The Bell YH-40, the service test version of the HU-1A Iroquois.

THE BELL MODEL 204.
U.S. Army designation: HU-1A Iroquois.

In 1955 Bell won an Army Competition for the development of a utility helicopter to be suitable for front-line evacuation of casualties, general utility missions and as an instrument trainer.

Known as the HU-1A Iroquois (formerly the H-40), the new aircraft is powered by a Lycoming T53 free-power shaft-turbine which develops 825 s.h.p. and is capable of running on a wide variety of fuels, including JP-4, all-purpose automotive, aviation spirit and kerosene. Three prototypes have been built, of which the first flew for the first time on October 22, 1956. In addition, fifteen service test models are being produced, and an initial order for 47 production HU-1A's has been placed by the U.S. Army.

TYPE.—Six-seat utility Helicopter.

ROTORS.—Two-blade main rotor and two-blade anti-torque tail rotor. Usual Bell-type stabilising bar above and at right angles to main rotor. Underslung feathering axis hub. Rotor shaft-driven by gas-turbine engine. Main rotor disc area 1,520 sq. ft. (141.2 m.²).

FUSELAGE.— All-metal semi-monocoque structure.

LANDING GEAR.—Tubular skid type.

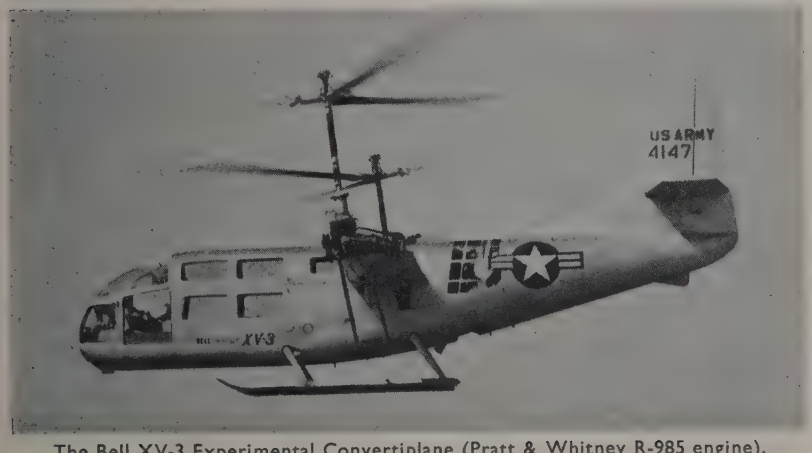
POWER PLANT.—One 825 s.h.p. (derated to 700 s.h.p.) Lycoming T53-L-1 shaft-turbine mounted above fuselage to rear of cabin.

ACCOMMODATION.—Pilot and five passengers, or stretchers, or freight in totally-enclosed cabin, with two doors on each side.

DIMENSIONS.—
Diameter of main rotor 44 ft. (13.4 m.).
Max. length 53 ft. (16.15 m.).
Height 12 ft. (3.36 m.).

WEIGHTS.—
Empty weight 3,791 lb. (1,719 kg.).
Max. gross weight 5,800 lb. (2,631 kg.).

PERFORMANCE.
Max. speed 141 m.p.h. (227 km.h.).
Hovering ceiling 14,400 ft. (4,400 m.).
Rate of climb at S/L 2,100 ft./min. (640 m./min.).
Normal range 202 miles (325 km.).



The Bell XV-3 Experimental Convertiplane (Pratt & Whitney R-985 engine).

THE BELL MODEL 200.
U.S. Army designation: XV-3.

The XV-3 is an experimental Convertiplane which has been developed by Bell and the U.S.A.F. Research and Development Command for the U.S. Army under a joint Army-Air Force contract.

The XV-3 Convertiplane, which was originally designated XH-33, is of the tilting-rotor type and combines the features of both the helicopter and the aeroplane.

Two combination rotor/propellers, mounted near the tips of the fixed wing, operate as conventional lifting rotors during take-off, landing and low-speed flight and as aircraft propellers for horizontal cruise and high-speed flight.

The tilting of the rotors is by electric motors enclosed in fairings at the wing tips and their movement through their full range from horizontal to vertical attitudes can be accomplished in from 10 to 15 seconds. The pilot can stop or reverse the conversion at any point, steady stable flight being maintained with the rotor/propellers in any intermediate position.

Originally, three-blade articulated rotors were fitted, but tests of a new two-bladed semi-rigid rotor system, with underslung feathering axis hubs, were started early in 1957.

Power is supplied by a Pratt & Whitney R-985 engine located behind the cabin, which seats four. An improved version of the Bell helicopter-type skid landing gear is fitted.

As a helicopter, the XV-3 will be capable of hovering or flying forward, backward or sideways, and will be able to operate into and out of confined areas. As an aeroplane the XV-3 will operate as a medium-range aircraft with a maximum speed of 160 m.p.h. (258 km.h.) at 2,500 ft. (760 m.).

The first XV-3 made its first vertical flight on August 23, 1955, and had successfully made 15° conversions in flight before it was badly damaged in a crash landing on October 25, 1956. Development is being continued with the second XV-3, which was subjected to full-scale wind-tunnel tests before entering its flight test programme with the new two-blade rotors. The wind tunnel tests included complete conversions and flight at simulated speeds up to 170 m.p.h. (275 km.h.).

DIMENSIONS.—
Diameter of rotors 25 ft. (7.62 m.).
Span of fixed wings 30 ft. (9.15 m.).
Length of fuselage 30 ft. (9.15 m.).
Height 13 ft. 6 in. (4.11 m.).
Rotor disc area 982 sq. ft. (91.23 m.²).

THE BELL MODEL 47G AND 47G-2.
U.S.A.F. designation: H-13.
U.S. Army name: Sioux.
U.S. Navy designation: HTL.

Since it delivered its first Model 47 in January, 1947, Bell has produced eight commercial models. They are the 47B, which had an enclosed, automobile-type cabin; the 47B-3, which had an open cockpit; the 47D, which had an all-Plexiglas cabin for greater visibility,

plus weather protection, the 47D-1, the 47G and 47G-2, 47H and 47J.

The model 47H, a de luxe version of the 47G, and the model 47J, a four-seat utility version of the 47G are described separately.

The 2,000th model 47, a 47J, was completed on December 11, 1957.

Compared with the earlier versions, the 47G has a small elevator which is geared to work in conjunction with rotor tilt. This permits an increase in permissible C.G. travel and greatly improves stability. There are two versions as follows :—

Model 47G. Standard model with 200 h.p. Franklin 6V4-200-C32 engine.

Model 47G-2. Similar to 47G, but with Lycoming VO-435 engine, derated to 200 h.p. This permits maximum power to be maintained to 5,000 ft. (1,525 m.) and offers longer engine life.

The following are the current military versions of the 47G and 47G-2.

XH-13F. (Bell Model 201). This is an experimental craft powered by a Continental-Turbomeca T51-T-3 Artouste shaft turbine engine.

H-13G. Military version of standard 47G. Can carry two external litters.

H-13H. Military version of 47G-2, with stretcher evacuation kits, two radios, dual controls, new-type skid landing gear and bonded all-metal rotor blades.



The Bell Model 47G-2 Utility Helicopter (200 h.p. Lycoming engine).



The Bell H-13H Utility Helicopter (200 h.p. Lycoming VO-435 engine).

Original U.S. Army contract for 189 increased to over 300, extending production into 1960. An H-13H set up an international helicopter endurance record of 57 hr. 50 min. in 1956, by refuelling whilst hovering just clear of the ground at regular intervals. Others are being evaluated for close support duties, carrying machine-guns, rockets and other armament in packs mounted on the landing gear.

H-13J. See under Bell Model 47J.

HTL-6. Naval training version of 47G. All supplied with skid landing-gear but float kits provided for proportion.

HTL-7. See under Bell Model 47J.

The description which follows refers specifically to the three-seat utility model 47G.

TYPE.—Three-seat General Utility Helicopter.

ROTORS.—Two-blade main rotor and controllable-pitch anti-torque rotor. Main rotor hub mounted on transmission mast by universal joint and provided with a stabilizing bar below and at right angles to the blades. A swash-plate revolving with the mast but free to move up and down provides cyclic pitch-control. Lower half of swash-plate which does not revolve alters pitch of the blades differentially for directional control. Main rotor drive through a centrifugal clutch and a two-stage planetary transmisson with a 9 : 1 reduction ratio. Free-wheeling mechanism incorporated in transmission. Transmission furnishes power take-offs for tail rotor drive, cooling fan and accessories and pulleys. Main rotor blades of symmetrical aerofoil section, are of laminated wood with a steel insert in leading-edge for strength and mass-balance. (H-13H has bonded metal blades). Blade area (each) 17.67 sq. ft. (1.64 m.²). Disc area 965 sq. ft. (89.65 m.²). Pre-coning angle 2.5 degrees. Metal anti-torque rotor blades. Blade area (each) 1.2 sq. ft. (0.11 m.²). Disc area 25.31 sq. ft. (2.35 m.²).

FUSELAGE.—In three sections; centre, tail and cabin. Centre section has a welded tubular steel framework which provides for mounting the engine and supports the cabin. Rear section is also a tubular structure, is triangular in cross-section and serves as a support for the anti-torque rotor drive-shaft. Small synchronised elevator surface at rear end of fuselage responds to the fore and aft motion of the cyclic-pitch control, provides better stability and allows a greatly increased C.G. travel.

LANDING GEAR.—Tubular skid type. Skid tread 7 ft. 6 in. (2.28 m.). Small ground handling wheels and tie-down and towing attachments provided. Four-wheel landing-gear may be supplied for training and other missions requiring considerable handling. The two forward self-castoring wheels capable of swivelling through 360°, the two rear wheels fixed. Wheel track 5 ft. 10¼ in. (1.78 m.). For amphibious use two air-inflated nylon floats are easily attached.

POWER PLANT.—One vertically-mounted 200 h.p. Franklin 6V4-200-C32AB (0-355-5) six-cylinder horizontally-opposed fan-cooled engine with clutch, drive shaft and rotor assembly in an integral unit in a steel-tube framework with the engine supported in rubber mounts at the top and bottom and attached to the welded framework of the forward fuselage. The engine-mounting structure has three attachment points for the rear fuselage. Engine controls include throttle, carburettor, hot air and carburettor mixture. The throttle is located on the main rotor pitch control lever and drives through a cam which automatically compensates for varying power requirements as the main rotor pitch control lever is actuated. Two interconnected saddle-mounted fuel tanks (43 U.S. gallons = 172.5 litres total capacity) on C.G. and with gravity feed.

ACCOMMODATION.—Side-by-side seating for three in enclosed compartment. The compartment is covered by a full-blown Plexiglas canopy with doors attached. For fair weather or specialised operations the doors are quickly removable. The Model 47G-2 can carry 440 lb. (200 kg.) cargo instead of passengers.

CONTROLS.—Conventional control stick for tilting main rotor by cyclic rotor blade angle change. Adjustable friction device on stick used to regulate control sensitivity. Main rotor pitch control lever located at left side of each seat. Rudder pedals connected to pitch-changing mechanism on tail rotor for torque compensation and directional control.

EQUIPMENT.—Standard equipment includes complete VFR flight and engine instruments, hydraulic boost control, 28-volt/50 amp. generator, electric starter, ground handling wheels, heavy-duty battery, etc. Additional accessories available in CAA-approved kits include floats, night flying equipment, dusting and spraying equipment, cargo carriers, dual controls, etc.

DIMENSIONS.—

Diameter of main rotor 35 ft. 1½ in. (10.72 m.).



The Bell HTL-7, the U.S. Naval training version of the Bell Model 47J.

Overall length (main rotor fore-and-aft) 41 ft. 5 in. (12.62 m.).
Length of fuselage (tail rotor vertical) 27 ft. 4 in. (8.33 m.).
Width (over landing gear) 8 ft. 6 in. (2.59 m.).
Height 9 ft. 5 in. (2.87 m.).
Diameter of tail rotor 5 ft. 8 in. (1.72 m.).

WEIGHTS (Model 47G).—
Weight empty (standard 2 or 3 seater) 1,435 lb. (651 kg.).
Max. certificated weight 2,350 lb. (1,067 kg.).

WEIGHTS (Model 47G-2).—
Weight empty 1,564 lb. (709 kg.).
Weight loaded 2,450 lb. (1,111 kg.).

PERFORMANCE (Model 47G at 2,350 lb.=1,066 kg. A.U.W.).—
Max speed 86 m.p.h. (138 km.h.).
Cruising speed 70 m.p.h. (113 km.h.).
Max. rate of climb at S/L 780 ft./min. (238 m./min.).
Time to 5,000 ft. (1,525 m.) 8.2 min.
Service ceiling 10,900 ft. (2,718 m.).
Absolute ceiling 12,500 ft. (3,815 m.).
Hovering ceiling in ground effect 3,600 ft. (1,098 m.).
Range 212 miles (341 km.).
Endurance 3.5 hours.

PERFORMANCE (Model 47G-2).—
Max. speed 100 m.p.h. (161 km.h.).
Hovering ceiling in ground effect 10,850 ft. (3,310 m.).
Range 238 miles (383 km.).

THE BELL MODEL 47H-1 BELLAIRUS.

The Model 47H-1 is a de-luxe version of the 47G. It has an enclosed sound-proofed cabin 60 in. (1.525 m.) wide which can accommodate a pilot and two passengers on an automobile-type cross seat. Interior appointments include leather upholstery throughout and a leather-covered instrument console grouping all electrical switches and carburettor controls to the left of the pilot. A metal monocoque tail-boom contains a baggage compartment large enough to carry luggage for all occupants. Can be adapted to carry 398 lb. (180 kg.) of cargo instead of passengers.

The rotor-system, power-plant, hydraulic boost control and synchronised elevator are the same as for the Model 47G.

DIMENSIONS.—
As for Model 47G, except height 9 ft. 3 in. (2.82 m.).

WEIGHTS.—
Weight empty 1,502 lb. (681 kg.).
Weight loaded 2,350 lb. (1,067 kg.).

PERFORMANCE.—
Max. speed 100 m.p.h. (161 km.h.).
Cruising speed 88 m.p.h. (142 km.h.).
Rate of climb 820 ft./min. (250 m./min.).
Service ceiling 12,000 ft. (3,660 m.).
Hovering ceiling in ground effect 4,300 ft. (1,310 m.).
Absolute ceiling 13,700 ft. (4,180 m.).
Normal range 211 miles (339 km.).

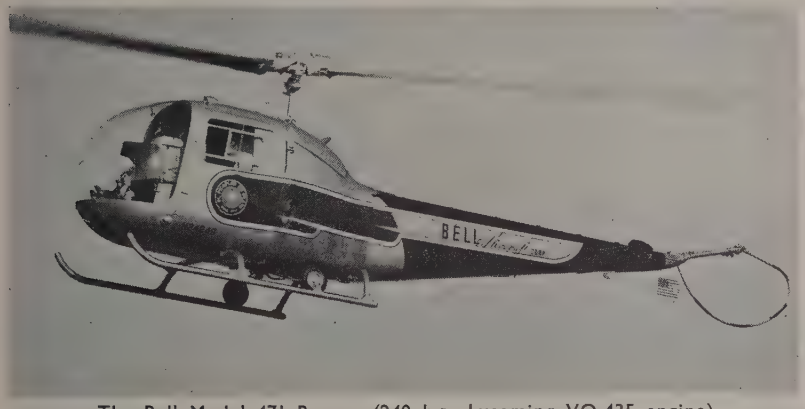
THE BELL MODEL 47J RANGER.
U.S.A.F. designation: H-13J.
U.S. Navy designations: HUL-1 and HTL-7.

The Model 47J is a four-seat utility version of the 47G. The enclosed cabin seats the pilot centrally in front, with three passengers on a cross bench aft. The passenger seat can be removed to allow for the installation of two stretchers on a parallelogram rack such as is used in typical Army field ambulances, plus a jump seat for a medical attendant; with the port door removed a trap can be raised to permit use of an internal electrically-powered hoist for rescue work; or the passenger seat can be folded back to leave clear space for cargo. Conversion to any of the cabin configurations can be made in the field in a matter of minutes without the use of tools. Alternative skid or pontoon landing gear can be fitted.

The 47J is powered by a 260 h.p. Lycoming VO-435 engine de-rated to develop 240 h.p. for two minutes, with a continuous output of 220 h.p.



The Bell Model 47H-1 Bellairus (200 h.p. Franklin engine).



The Bell Model 47J Ranger (240 h.p. Lycoming VO-435 engine).

Three military versions have been announced, as follows:—

H-13J. Two for use by President Eisenhower. Equipped to carry three persons. Specially furnished.

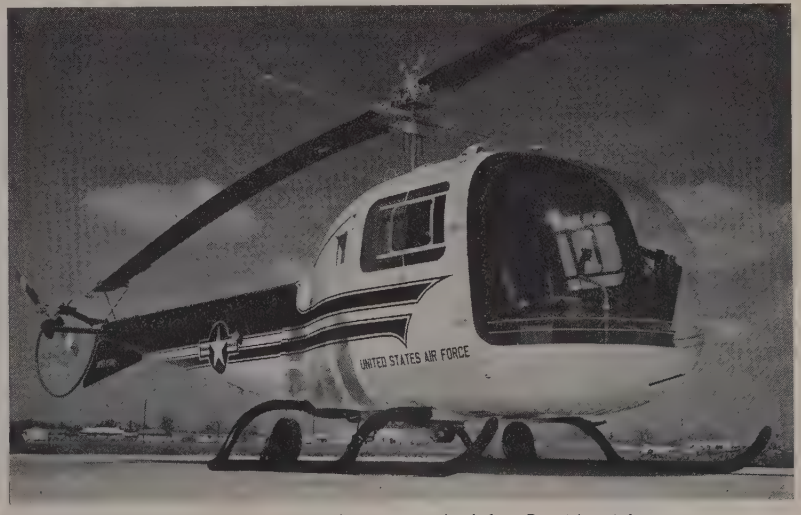
HUL-1. Standard Model 47J in production for general utility and ice breaker patrol duties with U.S. Navy. Alternative pontoon landing gear. Two HUL-1's were fitted with HTL-7 flight instruments for operational tests in the Antarctic with the U.S. Navy's IGY Operation Deepfreeze III expedition in 1957-58.

HTL-7. Training version for U.S. Navy, ordered into production in 1957. Has HUL-1 airframe from the firewall back, with completely re-styled cabin containing all-weather flight instruments, dual controls and side-by-side seating for pilot and co-pilot. The Navy will use this helicopter for both basic flying and instrument training, eliminating present need for two different types. Eighteen ordered, of which the first was delivered in December, 1957. Two will be used by Bell for Army-Navy Instrument Programme to develop ideal helicopter instrumentation and for Navy helicopter development programmes.

DIMENSIONS.—
Diameter of main rotor 37 ft. 2 in. (11.33 m.).
Overall length (main rotor fore and aft) 43 ft. 4 in. (13.2 m.).
Height 9 ft. 4 in. (2.84 m.).

WEIGHTS.—
Weight empty 1,618 lb. (734 kg.).
Max. loaded weight 2,800 lb. (1,270 kg.).

PERFORMANCE (at normal A.U.W. of 2,565 lb. =1,164 kg.).—
Max. speed 105 m.p.h (169 km.h.).
Cruising speed 100 m.p.h. (160 km.h.).
Service ceiling 17,000 ft. (5,180 m.).



The Bell H-13J, one of two supplied for Presidential use.



The Bell HSL-1 Anti-Submarine Helicopter (1,900 h.p. Pratt & Whitney R-2800 engine).

Hovering ceiling in ground effect 7,400 ft. (2,257 m.).
Normal range 200 miles (322 km.).

THE BELL MODEL 61.
U.S. Navy designation: HSL-1.

The HSL-1 is a large tandem-rotored helicopter which was designed specifically for anti-submarine warfare. The prototype flew on March 4, 1953, followed within a year by the first production type HSL-1's for the U.S. Navy.

The tandem-rotored HSL-1 marks the Bell company's first departure from its familiar single-rotor configuration which has been used in all Bell helicopters since 1942. Each of the two rotors incorporates the basic Bell rotor principles, characterised by the rigid two-blade rotor and automatic stabilising bar. The fore and aft rotors are interconnected and power is supplied by a 1,900 h.p. Pratt & Whitney R-2800-50 engine in a buried installation. The rotors can be folded to enable the helicopter to negotiate the elevators in aircraft-carriers or other types of ship. Total fuel capacity is 425 U.S. gallons (1,610 litres).

The HSL-1 is equipped with dipping sonar for submarine detection and is armed with lightweight homing weapons for the destruction of undersea craft. A Bell-developed helicopter auto-pilot permits the HSL-1 to hover motionless for long periods during a search operation.

The HSL-1 carries a crew of four, a pilot, co-pilot and two sonar operators. It has a flight endurance of nearly four hours and maximum speed of 115 m.p.h. (185 km.h.) at sea level.

DIMENSIONS.—
Rotor diameter (both) 51 ft. 6 in. (15.7 m.).
Length of fuselage 39 ft. 2¾ in. (11.9 m.).
Overall height (over rear rotor pylon) 14 ft. 6 in. (4.4 m.).
Width (rotors folded) 11 ft. 8½ in. (3.5 m.).
Rotor disc area 4,170 sq. ft. (387.4 m.²).

WEIGHT.—
Loaded weight 26,500 lb. (12,020 kg.).

BENSEN

BENSEN AIRCRAFT CORPORATION.

HEAD OFFICE AND WORKS: RALEIGH-DURHAM AIRPORT, RALEIGH, NORTH CAROLINA.

President: Igor B. Bensen.

The Bensen Aircraft Corporation was formed by Mr. Igor B. Bensen, formerly Chief of Research of the Kaman company, to develop a series of lightweight helicopters and rotary-wing gliders.

Production is now centred on the Models B-7M and B-8M Gyro-Copter powered autogyros, and various land and water-borne versions of the B-7 and B-8 rotor-kites. By the Autumn of 1957, about 100 Gyro-Copters had been sold. As many as 100 Gyro-Gliders and 700 kits of parts for amateur construction of these aircraft have been sold in a single year to 73 different countries.

THE BENSEN MODEL B-7 GYRO-GLIDER.

The Gyro-Glider is a simple unpowered single-seat rotor-kite which can be towed behind even a small motor car. It is available as either a completed aircraft or kit of parts for amateur construction. Alternatively, would-be constructors can purchase a set of plans, with building and flying instructions. No pilot's licence is required to fly it in the United States and many hundreds of kits and plans have been sold. Application has been made for an Approved Type Certificate.

The Model B-7 consists basically of an inverted tubular aluminium T-frame structure, of which the forward arm supports the lightweight seat, towing arm, rudder bar and landing gear nose-wheel. The rear arm supports a large stabilising fin and rudder, with the main landing gear wheels carried on a tubular axle at the junction of the T-frame. The free-turning two-bladed rotor is universally-mounted at the top of the T-frame and is operated directly by a hanging-stick control. It is claimed that the entire aircraft can be made from commercial tubing, wood and locally-available materials.

THE BENSEN MODEL B-7W HYDRO-GLIDER.

The basic structure of this floatplane rotor-kite is similar to that of the B-7 Gyro-Glider and conversion from one to the other is simple. Main changes are that the nose-wheel landing gear is replaced by three floats, the rear pair of which are built integrally with twin stabilising fins. It is towed by a motor-boat.

THE BENSEN MODEL B-8W HYDRO-GLIDER.

This new version of the Hydro-Glider has only two floats, made of Fiberglas. Each float is 9 ft. (2.75 m.) long and is of streamlined design to permit gentle landings on comparatively rough water.

THE BENSEN B-7B GYRO-BOAT.

The Gyro-Boat is a further variant of the Gyro-Glider, in which the basic free-turning rotor system, known as the Roto-sail, is mounted on any standard small dinghy. The result is literally a flying boat, intended to be towed above water by a motor boat.

The two-blade steel and plywood rotor has a diameter of 20 ft. (6.10 m.) and disc area of 314 sq. ft. (29.2 m.²). Each blade has an area of 10.8 sq. ft. (1.0 m.²). When fitted to a 12 ft. (3.66 m.) aluminium dinghy weighing 100 lb. (45 kg.), the complete Gyro-boat has an empty weight of 150 lb. (68 kg.) and a loaded weight of 325 lb. (147 kg.) carrying one person or 500 lb. (227 kg.) carrying two people.

It takes off when towed at a forward speed of 23 m.p.h. (37 km.h.), cruises at



The Bensen Model B-8W Hydro-Glider.

35-70 m.p.h. (55-110 km.h.) and lands at 7 m.p.h. (11 km.h.).

The prototype Gyro-Boat flew for the first time on April 25, 1956, and the first production model on July 8, 1956. The 1958 version can be fitted with stabilizing outriggers for rough water operation.

THE BENSEN MODEL B-7M GYRO-COPTER.

First flown on December 6, 1955, the Gyro-Copter is a powered autogyro conversion of the Model B-7 Gyro-Glider, designed for home-construction from kits or plans. The prototype took off after only two taxying trials, and, in its initial tests rose to 300 ft., demonstrating its manoeuvrability in figure-8 turns, cross-wind landings and take-offs and formation flying with two standard U.S. Army helicopters in winds up to 29 m.p.h. (46 km.h.). It has also been driven on main roads, in heavy traffic, under its own power and without any modifications, to show its roadability.

Power is provided normally by a 40 h.p. Nelson H-59 four-cylinder, horizontally-opposed air-cooled two-stroke engine, driving a two-blade wooden fixed-pitch propeller: but the Triumph 650 cc. motor-cycle engine is an approved alternative power plant for export models of the Gyro-Copter. The rotor is free-turning and, being permanently in the autorotation pitch range, needs no pitch change in the event of engine failure.

Controls consist only of a hanging stick, rudder pedals and throttle. A fixed one-piece tailplane is fitted to compensate for reduced fin area, and a fuel tank with a capacity of 6 U.S. gallons (22.5 litres) is provided. Conversion of a Gyro-Glider to power can be made in one day. Optional equipment includes float landing gear, radio, enclosed cabin and heater.

DIMENSION.—
Rotor diameter 20 ft. (6.10 m.).

WEIGHTS.—
Weight empty 185 lb. (83.92 kg.).
Payload 250 lb. (113.4 kg.).

PERFORMANCE.—
Cruising speed 60 m.p.h. (97 km.h.).



The Bensen Model B-7M Gyro-Copter (40 h.p. Nelson H-59 engine).

Min. speed in still air 19 m.p.h. (30.5 km.h.).
Ceiling (estimated) 12,000 ft. (3,660 m.).
Area required for landing and take-off 100 ft. × 100 ft. (30.5 m. × 30.5 m.).
Range 120 miles (193 km.).

THE BENSEN MODEL B-8M GYRO-COPTER.

This latest version of the Gyro-Copter has a more powerful engine and can be equipped with a mechanical rotor drive. By engaging this drive, the rotor can be accelerated to flying speed while the aircraft is stationary. Then, by transferring the power to the pusher propeller, it is possible to take off in only 50 ft. (15.25 m.), with the rotor autorotating normally.

The prototype Model B-8M Gyro-Copter flew for the first time on July 8, 1957, followed by the first production model on October 9, 1957.

TYPE.—Single-seat Light Autogyro.

ROTOR SYSTEM.—Single two-blade main rotor of laminated plywood construction, with steel spar. Teetering hub, with no lag hinges or collective pitch control. Area of each main rotor blade 5.83 sq. ft. (0.54 m.²). Total disc area 314 sq. ft. (29.17 m.²). No anti-torque rotor.

ROTOR DRIVE (optional).—Auxiliary flexible shaft for use only while aircraft is stationary. Rotor/engine r.p.m. ratio 1 : 10.

FUSELAGE.—Square-section tubular aluminium structure.

LANDING GEAR.—Fixed tricycle type, with auxiliary tail-wheel. No shock-absorbers. Steerable nose-wheel. General Tire wheels, size 12 in × 4 in. (30.5 × 10.15 cm.). Tyre pressure 10 lb./sq. in. (0.70 kg./cm.²). Brake on nose-wheel. Wheel track 4.0 ft. (1.22 m.). Wheelbase 5.0 ft. (1.52 m.).

POWER PLANT.—One 72 h.p. McCulloch Model 4318E four-cylinder horizontally-opposed air-cooled two-stroke engine, driving a two-blade wooden fixed-pitch Banks-Maxwell Model 45-24 pusher propeller, diameter 3 ft. 9 in. (1.14 m.). Fuel tank under pilot's seat, capacity 6.0 U.S. gallons (22.75 litres). Can be fitted with auxiliary tank for ferrying.

ACCOMMODATION.—Open seat for pilot, with overhead azimuth stick and rudder pedal controls. Safety belt.

DIMENSIONS.—
Rotor diameter 20 ft. 0 in. (6.10 m.).
Fuselage length 11 ft. 4 in. (3.45 m.).
Height 6 ft. 3 in. (1.90 m.).

WEIGHTS.—
Weight empty 247 lb. (112 kg.).
Weight loaded 500 lb. (227 kg.).

PERFORMANCE.—
Max. speed at S/L 85 m.p.h. (137 km.h.).
Cruising speed at S/L 60 m.p.h. (96.5 km.h.).
Min. speed in level flight 14 m.p.h. (22.5 km.h.).
Landing speed 7 m.p.h. (11.3 km.h.).
Max. rate of climb 2,000 ft./min. (610 m./min.).
Service ceiling 16,500 ft. (5,030 m.).
Take-off run, unpowered rotor, zero wind 300 ft. (91 m.).
Take-off run, powered rotor, zero wind 50 ft. (15.25 m.).
Landing run, 15 m.p.h. (24 km.h.) wind 0 ft.
Landing run, zero wind 20 ft. (6.10 m.),
Normal range 100 miles (160 km.).
Ferry range 300 miles (480 km.).
Endurance (normal) 1.5 hours.



The Bensen Model B-8M Gyro-Copter (72 h.p. McCulloch engine).

BILLMAN

BILLMAN AVIATION ASSOCIATES.

ADDRESS: MAYFIELD, NEW YORK.

This group was formed by Mr. Owen S. Billman who has designed and built a light aeroplane known as the Model B.11 Little Pink Cloud.

Work on the Model B.11 began as a result of Mr. Billman's membership of the Experimental Aircraft Association, which was founded to foster the design and construction of aircraft by the home craftsman.

The first B.11 flew on August 29, 1955. The latest B.11C version, which is described below, made its maiden flight on January 19, 1958.

THE BILLMAN MODEL B.11C. LITTLE PINK CLOUD.

TYPE.—Single-seat Light monoplane.

WINGS.—Shoulder-wing braced monoplane. Wing section Clark Y. Aspect ratio 6. Chord 4 ft. 2 in. (1.27 m.). Dihedral 3°. Incidence 1°. Two-spar spruce structure with fabric covering, except for aluminium alloy leading-edge. Vee streamlined bracing struts to lower longerons of fuselage. Frise type ailerons with aluminium structure and fabric covering. No flaps. Total area of ailerons 15.4 sq. ft. (1.43 m.²). Gross wing area 97 sq. ft. (8.01 m.²).

FUSELAGE.—Welded steel tube structure, with aluminium fairing strips and fabric covering.

TAIL UNIT.—Braced monoplane type. Welded steel tube structure with fabric covering. Fin integral with fuselage. Areas: fin 4.6 sq. ft. (0.43 m.²), rudder 5.0 sq. ft. (0.46 m.²), elevators 8.0 sq. ft. (0.74 m.²), tailplane 9.7 sq. ft. (0.80 m.²). Tailplane span 8 ft. (2.44 m.).

LANDING GEAR.—Fixed tail-wheel type, with two Vees and two half axles hinged to bottom longerons. Elastic cord shock absorption. Hayes wheels and brakes. Wheel track 5 ft. 10 in. (1.78 m.).

POWER PLANT.—One 80 h.p. Continental A80-8 four-cylinder horizontally-opposed air-cooled engine driving McCauley metal fixed-pitch airscrew. Fuel tank aft of engine firewall, capacity 12 U.S. gallons (45 litres). Oil capacity 5 U.S. quarts (4.5 litres).

ACCOMMODATION.—Single seat under rearward-sliding plexiglas canopy. Entry by

means of stirrup step on lower port longeron and walkway at root of port wing. Baggage compartment aft of seat.

DIMENSIONS.—
Span 24 ft. 3 in. (7.39 m.).
Length 17 ft. 8 in. (5.38 m.).
Height 5 ft. 2 in. (1.57 m.).

WEIGHTS AND LOADINGS.—
Weight empty 640 lb. (290 kg.).
Weight loaded 940 lb. (427 kg.).
Wing loading 9.7 lb./sq. ft. (47.3 kg./m.²).
Power loading 11.7 lb./h.p. (5.31 kg./h.p.).

PERFORMANCE.—
Max. speed 128 m.p.h. (205 km.h.).
Normal cruising speed (2,400 r.p.m.) 115 m.p.h. (185 km.h.).
Econ. cruising speed (2,200 r.p.m.) 108 m.p.h. (173 km.h.).
Stalling speed 55 m.p.h. (88 km.h.).
Rate of climb at S/L 1,500 ft./min. (457 m./min.).
Cruising range 280 miles (450 km.).



The Billman Model B.11C Little Pink Cloud.

BOEING

THE BOEING AIRPLANE COMPANY.

HEAD OFFICE: SEATTLE 24, WASH.

AIRCRAFT MANUFACTURING DIVISIONS: SEATTLE, WASH., WICHITA, KANSAS, AND TRANSPORT DIVISION, RENTON, WASH.

OTHER DIVISIONS: PILOTLESS AIRCRAFT DIVISION AND INDUSTRIAL PRODUCTS DIVISION AT SEATTLE, WASH.

Established: July, 1916.
Chairman: C. L. Egtvedt.
President: William M. Allen.
Senior Vice-President: Wellwood E. Beall.

Vice-President in charge of Engineering: Edward C. Wells.
Vice-President in charge of Manufacturing: F. P. Laudan.
Vice-President in charge of Operations: C. B. Gracey.
Vice-President in charge of Labour Relations: A. F. Logan.
Vice-President in charge of Finance: J. O. Yeasting.
Vice-President in charge of Administration and Secretary: J. E. Prince.

SEATTLE DIVISION.
Vice-President and General Manager: G. C. Martin.
Chief Engineer: H. W. Withington.

PILOTLESS AIRCRAFT DIVISION.
Vice-President and Chief Engineer: L. A. Wood.
Chief Engineer: R. H. Jewett.

TRANSPORT DIVISION.
Vice-President and General Manager: J. B. Connelly.
Chief Engineer: M. L. Pennell.

WICHITA DIVISION.
Vice-Chairman: J. E. Schaefer.
Vice-President and General Manager: N. D. Showalter.
Chief Engineer: T. E. Gamlen.
Vice-President and Eastern Representative: J. P. Murray.
Treasurer: Evan M. Nelsen.
Controller: Clyde Skeen.

At the beginning of 1958 the Boeing Airplane Company was engaged in production of the B-52 eight-jet heavy bomber; the KC-135 Stratotanker jet tanker-transport; the Model 707 Stratoliner jet airliner and the IM-99 Bomarc interceptor missile.

The KC-135, which is a military version of the Model 707, was ordered into production in September, 1954, and is replacing the KC-97 as the standard aerial tanker for the B-52 wings of the U.S.A.F. Strategic Air Command. The first KC-135 made its first flight on August 31, 1956.

The first production 707 made its maiden flight on December 20, 1957 and at the time of writing was undergoing Boeing and C.A.A. certification flight-testing. The 707 is scheduled to go into airline service over the North Atlantic late in 1958. The 720 short-to-medium range airliner was announced in 1957.

In 1957 B-52 production was continued at both Seattle and Wichita. Production of complete aircraft at Seattle was to be terminated in the Autumn of 1958 although manufacture and assembly of components in support of Wichita production will continue.

Production of the smaller B-47 Stratojet was phased-out at Boeing-Wichita in October, 1956, and this type is no longer being built. It is, however, still in widespread service.

Boeing's Pilotless Aircraft Division was formed early in 1953 and has developed and is currently producing the IM-99 Bomarc supersonic interceptor missile. Early in 1958 it was announced that two new projects were under way, an advanced model of the present Bomarc and an anti-ballistic missile system.

In 1958 Boeing announced the establishment of the Boeing Scientific Research Laboratories to work in the field of basic research and "to develop new fundamental knowledge at the frontiers of science."

At the end of 1957, employment at the Boeing plants in the Seattle area totalled approximately 60,000 and at Wichita 30,000.

THE BOEING MODEL 707 STRATOLINER.

U.S. Air Force designations: KC-135 and VC-137.

The Boeing Model 707 was the first American jet transport to be completed and flown. It made its first flight on July 15, 1954.

The Model 707 prototype was built as a private venture, primarily as a demonstrator tanker-transport which, in developed form, would be able to refuel present and future jet bombers, fighters and reconnaissance aircraft at or near their operational altitudes and speeds.

In August, 1954, it was announced that Boeing had received a production contract from the U.S.A.F. for an advanced tanker-transport version of the 707, to be known as the KC-135 Stratotanker. Substantial additional orders have since been received and it was stated in March, 1957 that over 400 will be built.

On July 13, 1955, Boeing was given clearance by the U.S.A.F. to build a commercial jet aircraft concurrently with the production of military jet tanker-transports, and five types of jet airliners the 707-120, 707-220, 707-320, 707-420 and 720 have been announced. Up to the time of closing for press a total of 182 of the various versions had been



The Boeing Stratoliner Model 707-121 (four Pratt & Whitney JT3 engines) for Pan American World Airways.



The Boeing Stratoliner Model 707-123 (four Pratt & Whitney JT3 engines) for American Airlines.

ordered. In addition, three have been ordered by the U.S.A.F. for use of the Presidential Staff, under the designation of VC-137A.

The basic versions of the 707 can be identified as follows :—

707-80. The prototype 707 tanker-transport which first flew on July 15, 1954. Powered by four Pratt & Whitney JT3C-1 (J57) turbojet engines (10,500 lb. =4,765 kg. s.t. each) A.U.W. 190,000 lb. (86,260 kg.). Span : 129 ft. 8 in. (39.5 m.), length : without refuelling boom 119 ft. 6 in. (36.42 m.), with boom 127 ft. 10 in. (38.9 m.), height : 38 ft. 3 in. (11.6 m.).

707-023. This is, in fact, a version of the Model 720 (which see). Twenty-five ordered by American Airlines for delivery beginning in 1960.

707-120. Basic civil production version intended primarily for continental use but capable of full-load over-ocean operation on many routes. Fuselage length increased to 138 ft. 6 in. (42.24 m.) and width increased by 16 in. (0.41 m.) to 148 in. (3.76 m.). Four Pratt & Whitney JT3C-4 (J57) turbojet engines (12,500 lb. =5,670 kg. s.t. each). Standard accommodation for 124 first class, 124 combined first-class/tourist or 150 tourist passengers. Maximum A.U.W. 248,000 lb. (112,000 kg.). First production aircraft, a 707-121 for Pan American World Airways, flew for first time on December 20, 1957.

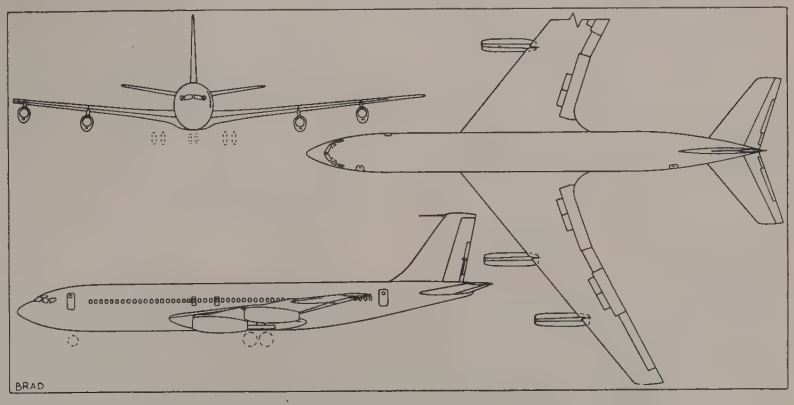
707-220. Same airframe and accommodation as 707-120 but powered by four Pratt & Whitney JT4A-3 (J75) engines of greater power. Same overall dimensions as 707-120. Maximum A.U.W. 248,000 lb. (112,000 kg.).

707-320 Intercontinental. Enlarged long-range over-water version powered by four Pratt & Whitney JT4A-3 (J75) turbojet engines. Fuselage length increased to 145 ft. 6 in. (44.37 m.). Standard day accommodation for 131 first-class, 124 combined first-class/tourist or 162 tourist passengers. Maximum A.U.W. 296,000 lb. (134,000 kg.). The 13th production 707 will be the first 707-320 and was due to fly in October, 1958.

707-420 Intercontinental. As 707-320 but powered by four Rolls-Royce Conway Mk. 505 turbojet engines.

KC-135A Stratotanker. Tanker-transport version developed from the 707 prototype as standard aerial tanker for U.S.A.F. Strategic Air Command. In production. First KC-135A flew on August 31, 1956, and the first delivery was made to Castle Air Force Base, Cal., on May 18, 1957.

VC-137A. Three Model 707-120's ordered by the U.S.A.F. for use by



The Boeing Stratoliner Model 707-320 Intercontinental.

BOEING JET STRATOLINER MODELS.

Model No.	Airline	Quantity ordered	Power-plant	Date of 1st delivery
707-023 (720)	American Airlines	25	4 x Pratt & Whitney JT3	Early 1960
707-121	Pan American	6	,, ,, ,,	September 1958
707-123	American Airlines	25	,, ,, ,,	October 1958
707-124	Continental Air Lines	4	,, ,, ,,	May 1959
707-131	T.W.A.	15	,, ,, ,,	December 1958
707-138	Qantas	7	,, ,, ,,	May 1959
707-139	Cubana	2	,, ,, ,,	March 1960
707-150 (VC-137)	U.S.A.F.	3	,, ,, ,,	Spring 1959
707-227	Braniff	5	4 x Pratt & Whitney JT4	October 1959
707-321	Pan American	17	,, ,, ,,	August 1959
707-328	Air France	17	,, ,, ,,	November 1959
707-329	Sabena	4	,, ,, ,,	December 1959
707-331	T.W.A.	18	—	Late 1959
707-344	South African Airways	2	,, ,, ,,	July 1960
707-430	Deutsche Lufthansa	4	4 x Rolls-Royce Conway	January 1960
707-436	B.O.A.C.	15	,, ,, ,,	December 1959
707-437	Air-India International	3	,, ,, ,,	January 1960
707-441	VARIG	2	,, ,, ,,	July 1960
720	United Air Lines	11	4 x Pratt & Whitney JT3	April 1960



The Boeing KC-135A Stratotanker (four Pratt & Whitney J57 turbojet engines).

Presidential Staff. First due for delivery in Spring of 1959.

The following description applies in general to the Model 707 Stratoliner Series :—

TYPE.—Four-engined Jet Airliner.

WINGS.—Swept-wing cantilever monoplane. 35° sweep at 25% of chord. Dihedral 7°. All-metal two-spar structure. Centre-section continuous through fuselage. Two double-slotted flaps on each wing panel. Lateral control at low speeds by normal outboard ailerons and small inboard ailerons, supplemented by two hydraulically-operated spoilers on each wing which are interconnected with the ailerons. Lateral control at high speeds by inboard ailerons and spoilers only. Operation of flaps adjusts linkage between inboard and outboard ailerons to permit outboard operation only with extended flaps. Spoilers may also be used symmetrically as speed brakes. Primary flight controls are manually-operated through spring-tabs. Small hydraulically-operated leading-edge flap immediately inboard of each outer engine nacelle. Gross wing area (707-120, -220, and 720) 2,433 sq. ft. (226 m.²), (707-320, -420) 2,892 sq. ft. (248.6 m.²).

FUSELAGE.—All-metal structure with cross section made up of two circular arcs of different radii, the larger above, faired into smooth-contoured elipse. Maximum external width of fuselage 148 in. (3.76 m.). Maximum external height of fuselage 14 ft. 2½ in. (4.33 m.).

TAIL UNIT.—Cantilever all-metal structure. Anti-balance tab and trim-tab in rudder. Trim and control tabs in each elevator. Electrically and manually operated variable-incidence tailplane. Rudder power-boosted at low speeds on all versions except 707-120. Span of tailplane (707-120, -220, and 720) 39 ft. 8 in. (12.09 m.), (707-320, -420) 45 ft. 9 in. (13.95 m.).

LANDING GEAR.—Retractable tricycle type. Main units are four-wheel bogies which retract inwardly into underside of thickened wing-root and fuselage. Dual nose-wheel unit retracts forward into fuselage. Landing gear doors close when legs fully extended. Gear can be extended in flight to give maximum rate of descent of 15,000 ft./min. (4,570 m./min.). Wheel-base (between centre-lines of shock-struts) (KC-135) 45 ft. 8 in. (13.92 m.), (707-120, -220) 52 ft. 4 in. (15.9 m.), (707-320, -420) 62 ft. 4 in. (19.1 m.), (720) 47 ft. 4 in. (14.42 m.). Track (between centre-lines of shock-struts) 22 ft. 1 in. (6.73 m.).

POWER PLANT.—Four Pratt & Whitney JT3 (707-120 and 720) or JT4 (707-220, -320) turbojet engines or four Rolls-Royce Conway by-pass turbojet engines (707-420) in four separate and interchangeable pods, two under each wing. All engines fitted with noise suppressors and thrust reversers. All fuel carried in wings in four interconnected integral interspar compartments accessible through manhole openings in lower wing surfaces. Fuel capacities : (720) 10,092 U.S. gallons (38,202 litres) (707-120, -220) 17,400 U.S. gallons (65,860 litres), (707-320, -420) 21,200 U.S. gallons (80,250 litres).

ACCOMMODATION.—Flight compartment seats pilot and co-pilot side-by-side, with stations for flight engineer and navigator behind. Main cabin, free of structural obstructions, can, according to versions and/or customer's requirements, seat from 110 to 162 passengers, five abreast in first class, or six abreast in tourist configurations. Galley, coatroom, and toilets at each end of cabin. Two passenger entrance doors. Baggage compartments, fore and aft of wing, in lower segment of fuselage below cabin floor. As for rest of accommodation, the compartments are pressurised to a differential of 8.6 lb./sq. in. (0.605 kg./cm.²), air-conditioned and temperature controlled. Baggage compartment capacities : forward 500 cub. ft. (14.1 m.³) in 720 ; 700 cub. ft. (19.8 m.³) in 707-120 and -220 ; 800 cub. ft. (22.7 m.³) in 707-320 and -420 ; aft 900 cub. ft. (25.5 m.³) in all models, except the 720 which has an aft baggage compartment volume of 735 cub. ft. (20.8 m.³).

DIMENSIONS (707-120 and 707-220).—
Span 130 ft. 10 in. (39.88 m.).
Length overall 144 ft. 6 in. (44.04 m.).
Height (over tail) 38 ft. 7 in. (11.75 m.).

DIMENSIONS (707-320 and 707-420).—
Span 142 ft. 5 in. (43.4 m.).
Length overall 152 ft. 11 in. (45.6 m.).
Height (over tail) 38 ft. 8 in. (11.78 m.).

DIMENSIONS (KC-135).—
Span 130 ft. 10 in. (39.88 m.).
Length overall 136 ft. 3 in. (41.53 m.).
Height 38 ft. 5 in. (11.71 m.).

WEIGHTS (707-120 and -220).—
Max. payload (707-120) 42,400 lb. (19,232 kg.).
Max. payload (707-220) 42,400 lb. (19,232 kg.).
Max. loaded weight 248,000 lb. (112,000 kg.).
Max. landing weight 175,000 lb. (79,000 kg.).

WEIGHTS (707-320 and -420).—
Max. payload 42,000 lb. (19,051 kg.).
Max: loaded weight 296,000 lb. (134,000 kg.).
Max. landing weight 195,000 lb. (88,435 kg.).

WEIGHT (KC-135).—
Weight loaded over 250,000 lb. (113,400 kg.).

PERFORMANCE (707-120).—
Max. cruising speed 591 m.p.h. (950 km.h.).
Take-off field length (I.S.A. at max. A.U.W.) 9,800 ft. (3,000 m.).
Landing distance from 50 ft. (15.25 m.) 6,300 ft. (1,920 m.).
Range with 35,965 lb. (16,315 kg.) payload in still air, with reserves, 3,300 miles (5,310 km.).

PERFORMANCE (707-220).—
Max. cruising speed 605 m.p.h. (972 km.h.).
Take-off field length (I.S.A. at max. A.U.W.) 7,000 ft. (2,135 m.).



The Boeing KC-135A Stratotanker (four Pratt & Whitney J57 turbojet engines).



An artist's impression of the Boeing Model 720, eleven of which have been ordered by United Air Lines.

Landing distance from 50 ft. (15.25 m.) 6,300 ft. (1,920 m.).
Range with 35,965 lb. (16,315 kg.) payload in still air, with reserves, 3,340 miles (5,375 km.).

PERFORMANCE (707-320).—
Max. cruising speed 605 m.p.h. (972 km.h.).
Take-off field length (I.S.A. at max. A.U.W.) 8,900 ft. (2,715 m.).
Landing distance from 50 ft. (15.25 m.) 6,400 ft. (1,950 m.).
Range with 34,965 lb. (15,860 kg.) payload in still air, with reserves, 4,730 miles (7,612 km.).

PERFORMANCE (707-420).—
Max. cruising speed 605 m.p.h. (972 km.h.).
Take-off field length (I.S.A. at max. A.U.W.) 8,600 ft. (2,623 m.).
Landing distance from 50 ft. (15.25 m.) 6,400 ft. (1,950 m.).
Range with 34,965 lb. (15,860 kg.) payload in still air, with reserves, 5,125 miles (8,248 km.).

PERFORMANCE (KC-135).—
Max. speed over 600 m.p.h. (965 km.h.).
Service ceiling over 35,000 ft. (10,670 m.).

THE BOEING MODEL 720

The Model 720 is the short-to-medium range member of the Boeing jet transport family. Although a completely new design from the weight and structural strength standpoints, the 720 is almost identical to the 707-120 in external outline and main dimensions, aerodynamic design and control systems. The strict adherence to an established physical design allows the use of 707 passenger cabin interiors, flight-deck, systems components and most 707 interchangeable and replaceable parts and spares.

The most important aerodynamic change is a refinement in the wing leading-edge, which increases the angle of sweep-back and decreases the thickness/chord ratio, with consequent improvement in take-off performance and cruising speed.

Major weight saving has been achieved by lightening the structure to the extent made possible by reducing the standard fuel load to 10,092 U.S. gallons (38,200 litres).

In its basic form, the 720 will be powered by four Pratt & Whitney JT3C (dry) turbojets and is designed to operate from existing airport runways on stage lengths of from 200 to 2,400 miles (320-3,860 km.).

Standard cabin furnishing provides accommodation for 110 first class passengers (five abreast), although the spaciousness of the seating area will permit an infinite number of interior variations in four, five and six abreast seating. A maximum of 149 tourist passengers can be accommodated in six-abreast seating.

Continuous floor tracks will permit the rapid conversion of the cabin seating while moveable partitions and coat stowage compartments can be installed to provide two-class service. Two standard baggage compartments are built into the pressurised portion of the fuselage, the forward compartment having a volume of 500 cub. ft. (14.1 m.^{3}) and the aft compartment a volume of 735 cub. ft. (20.8 m.^{3}). Two galleys, fore and aft toilet compartments, air conditioning, etc. are the same as for the 707-120.

DIMENSIONS.—
Same as for 707-120.

WEIGHTS (designed).—
Operating weight empty 103,145 lb. (46,786 kg.).
Max. payload 33,000 lb. (14,968 kg.).
Max. gross weight 203,000 lb. (92,080 kg.).
Max. landing weight 165,000 lb. (74,843 kg.).

PERFORMANCE (estimated).—
Mach number limitation 0.9 at 22,700 ft. (6,920 m.).
Cruising speed at 25,000-40,000 ft. (7,620-12,200 m.) 550-614 m.p.h. (885-988 km.h.).
C.A.R. take-off field length 5,400 ft. (1,645 m.).
C.A.R. landing field length 5,500 ft. (1,675 m.).
Range (max. payload) 1,700 miles (2,735 km.).
Range (full passenger payload) 2,400 miles (3,860 km.).

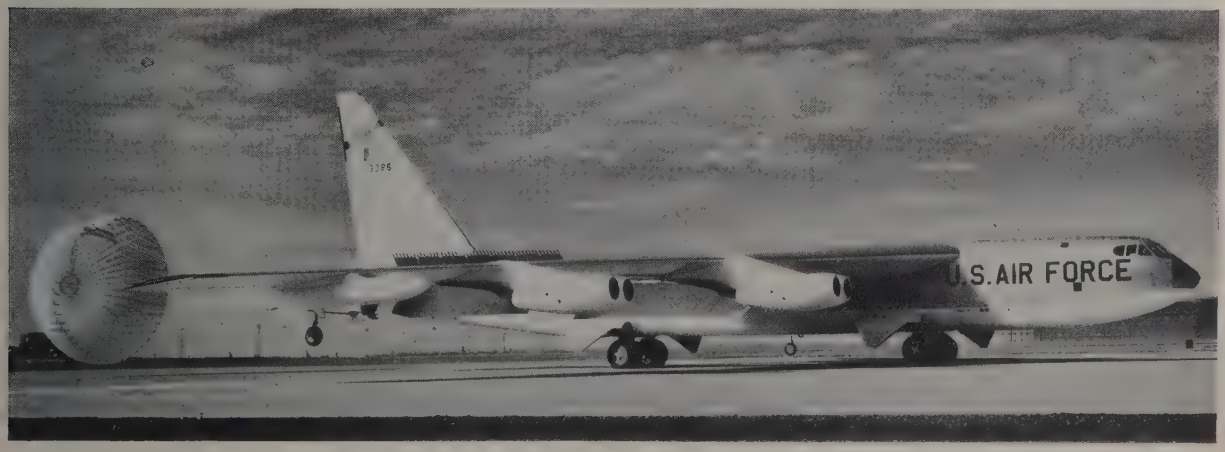
THE BOEING STRATOFORTRESS.
U.S. Air Force designation: B-52.

The B-52 is an eight-jet swept-wing long-range heavy bomber which is now in quantity production at the Seattle and Wichita plants. The first Seattle-produced B-52A was completed in March, 1954, while the first Wichita-produced Stratofortress, the first B-52D, was completed in December, 1955.

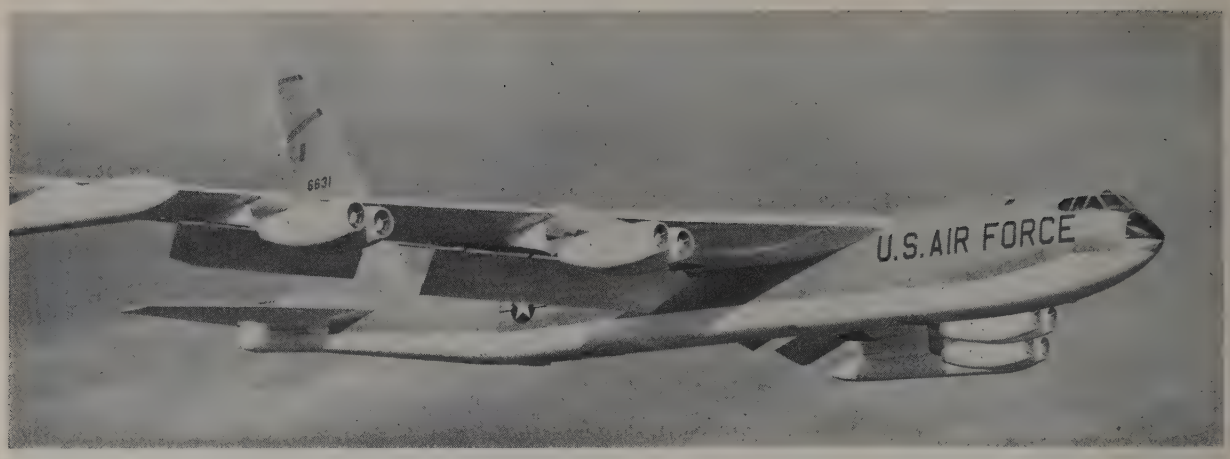
The following production versions of the B-52 have been announced :—

B-52A. Eight Pratt & Whitney J57-P-1W engines. First production model, with "cross-wind" landing gear and equipped to receive "flying boom" flight refuelling. First B-52A flew for first time on August 5, 1954. Fitted with two 1,000 U.S. gallon (3,780 litre) drop tanks under outer wings. Gross weight 350,000 lb. (158,900 kg.).

B-52B. Similar to B-52A but capable of undertaking more than one strategic rôle. In addition to bombing (conventional and nuclear) it can also be provided with "capsule" equipment for photographic reconnaissance and other, secret, duties. The "capsule" which may be winched in and out of the bomb-bay,



The Boeing B-52A Stratofortress Heavy Bomber (eight Pratt & Whitney J57 turbojet engines).



The Boeing B-52E Stratofortress Heavy Bomber (eight Pratt & Whitney J57 turbojet engines).

is fully pressurised, air-conditioned and is equipped with stations for a two-man crew. 30 built.

B-52C. Eight Pratt & Whitney J57-P-19W engines. Developed version of B-52B with same versatility. Larger underwing drop tanks. All-up weight increased to more than 400,000 lb. (181,600 kg.).

B-52D. Similar to B-52C but is a long-range heavy bomber exclusively.

B-52E. Developed version of the B-52D with improved bombing, navigation and electronics systems.

B-52F. Developed version of the B-52E with J57-P-43W engines with increased thrust.

B-52G. Developed version of B-52F with redesigned "wet" wing with integral skinning and integral fuel tanks. Vertical tail surfaces reduced in height. 25% greater range, increased climb performance and greater target altitude. Equipped to carry two GAM-77 Hound Dog air-to-surface missiles. Weight loaded approx. 450,000 lb. (204,000 kg.).

The following description refers to the B-52A :—

TYPE.—Eight-jet Heavy Bomber.

WINGS.—High-wing cantilever monoplane with anhedral and 35 degree sweepback. All-metal stressed-skin structure. Lateral control by inset ailerons between inner and outer flaps, supplemented by serrated spoilers on upper surface of wings. Spoilers can be used symmetrically as air brakes. Area-increasing flaps. Wing area approximately 4,000 sq. ft. (371.6 m.²).

FUSELAGE. — All - metal semi - monocoque structure.

TAIL UNIT.—Cantilever monoplane type, with hydraulically-actuated variable-incidence tailplane. All control surfaces operated manually through servo tabs.

LANDING GEAR.—Retractable tandem type. Four individually-retracted twin-wheel main units in tandem pairs, retracting into fuselage fore and aft of bomb-bay. Two forward units with hydraulic steering. All four units can be set at a selected degree of castor in flight or on ground for "cross-wind" landings. Small outrigger units retract inward into wings outboard of outer engine positions. Ribbon braking parachute, 48 ft. (14.6 m.) diameter, in container which extends under rear fuselage.

POWER PLANT.—Eight Pratt & Whitney J57 turbojet engines in pairs in four nacelles supported on forwardly-inclined cantilever struts under wings. Total fuel capacity approximately 35,000 U.S. gallons (132,485 litres) in wing and fuselage tanks, including two 1,000 U.S. gallon (3,787 litres) jettisonable tanks carried under wing-tips. Single pressure-refuelling point in forward starboard wheel bay. Provision for "flying boom" in-flight refuelling, with inlet on top of fuselage aft of cockpit.

ACCOMMODATION.—Crew of six. Forward pressurised cabin accommodates pilot, co-pilot and radio operator in upward-ejection seats on flight deck, with navigator and radar observer on downward-ejection seats on lower level. Rest bunk, kitchen and toilet on lower deck. Tail gunner has pressurised compartment linked by a crawlway with forward cabin. Crawlway can be used only when cabins de-pressurised. Tail-gunner's compartment is complete with own toilet and electric stove : entire gun and radar installation can be jettisoned for unobstructed exit in emergency. Cabins pressurised to differential of 8.77 lb./sq. in. (0.617 kg./cm.²).

ARMAMENT.—Four 0.50 in. guns in Bosch Arma MD-9 rear turret, with lock-on radar fire-control and periscopic optical sight. Maximum bomb load 75,000 lb. (34,000 kg.). Normal bomb load 25,000 lb. (11,340 kg.) for 3,500 mile (5,630 km.) range.

DIMENSIONS.—
Span 185 ft. (56.42 m.).
Length 156 ft. 6 in. (47.73 m.).
Height over tail 48 ft. 3½ in. (14.73 m.).

WEIGHT.—
Weight loaded over 400,000 lb. (181,600 kg.).

PERFORMANCE.—
Max. speed over 650 m.p.h. (1,040 km.h.).
Service ceiling over 50,000 ft. (15,250 m.).

THE BOEING STRATOJET.

U.S. Air Force designation : B-47.

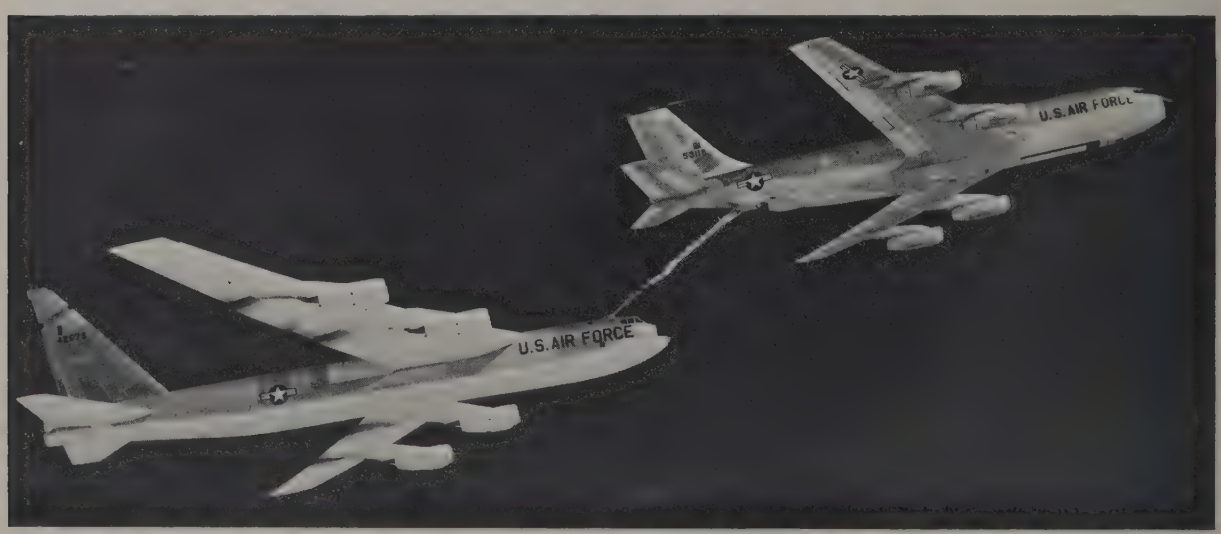
The B-47 was the first large jet-propelled aircraft to be fitted with sweptback wings and tail surfaces. Two prototypes were built, the first flying for the first time on December 17, 1947.

The first production order for the B-47 was placed in September, 1948, and the first production B-47A flew on June 25, 1950. Initially production was handled by Boeing-Wichita but in 1951 Douglas and Lockheed were brought into the programme, these two companies being responsible for B-47 production in Government-owned factories at Tulsa, Okla., and Marietta, Ga. respectively.

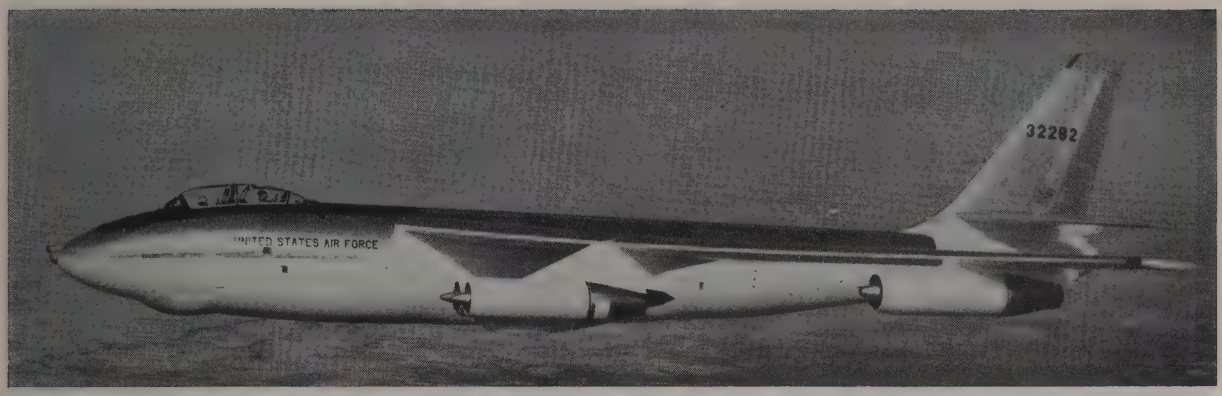
B-47 production was phased out at Boeing-Wichita in October, 1956 and at Douglas-Tulsa in December, 1956. Production ceased entirely with the acceptance of the final B-47E from Lockheed-Marietta on February 15, 1957.

The following are the main production versions of the B-47 :—

B-47A. Six General Electric J47-GE-11 engines (5,200 lb.=2,360 kg. s.t.). 18 individual Jato solid-fuel rockets



A Boeing B-52 Stratofortress being refuelled by a Boeing KC-135A Stratotanker using the Boeing "flying-boom" system.



The Boeing B-47E Stratojet Medium Bomber (six General Electric J47 turbojet engines).

fitted to give emergency take-off thrust of 20,000 lb. (9,080 kg.). First production B-47A flew for the first time on June 25, 1950.

B-47B. Six General Electric J47-GE-23 engines (5,800 lb.=2,630 kg. s.t.). Gross weight 185,000 lb. (84,000 kg.). Fitted with wing drop tanks. First B-47B flew on April 26, 1951. B-47B's have been modified and modernised up to B-47E standard by Boeing-Wichita. Modifications include installation J47-GE-25 engines and water-injection system to give 17% increased T.O. power; substitution of droppable 33-rocket T.O. assist for original internal 18-rocket equipment; installation of 16-foot approach parachutes; installation of ejection seats (pilot and co-pilot up, navigator down); re-arrangement of equipment in flight compartment and substitution of G.E. radar-directed tail gun-turret armed with two 20 mm. cannon for former .50-cal. guns. Modified B-47B's are known as B-47B II.

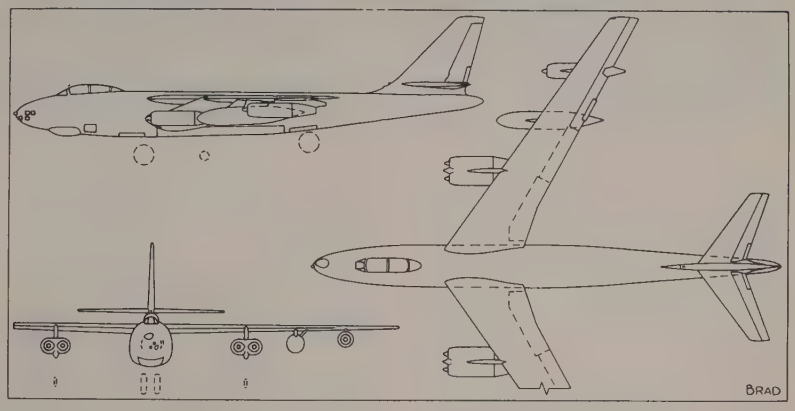
RB-47B. Conversion of B-47B for high-altitude photographic reconnaissance. Eight cameras and equipment in heated "package" can be installed in and removed from bomb-bay.

B-47E. Six General Electric J47-GE-25 engines (6,000 lb.=2,724 kg. s.t.). Developed version of B-47B. Remotely-controlled tail armament of two 20 mm. cannon. First B-47E flew on January 30, 1953. DB-47E operational with GAM-63 Rascal air-to-surface missile.

RB-47E. Day or night long-range photographic reconnaissance version of B-47E. Longer nose. Heated and air-conditioned camera compartment. Crew of three, pilot, co-pilot and photographer-navigator. First RB-47E flew on July 3, 1953. Length 109 ft. 10 in. (33.5 m.), other dimensions as for B-47E.

RB-47K. Similar to RB-47E but equipped for both photographic and weather reconnaissance.

The description which follows refers to the B-47E.



The Boeing B-47E Stratojet Medium Bomber.

TYPE.—Six-jet Medium Bomber.

WINGS.—Shoulder-wing cantilever monoplane with anhedral and 35 degree sweepback. Thin laminar-flow wing section. All-metal stressed-skin structure.

FUSELAGE.—Oval-section all-metal structure with flush-riveted stressed-skin covering.

TAIL UNIT.—Cantilever monoplane type. All-surfaces swept-back. All-metal structure.

LANDING GEAR.—Retractable tandem type. Two main twin-wheel units in tandem retracting forward into fuselage fore and aft of bomb-bay. Small outrigger wheel units retract into inboard engine nacelles.

POWER PLANT.—Six General Electric J47 turbojet engines, four paired in two nacelles supported on forwardly-inclined cantilever struts under inner wings and two in single nacelles under outer wings near tips. Auxiliary take-off power provided by rocket motors on a collar type rack mounted beneath the fuselage. Thirty-three JATO units of 1,000 lb. (454 kg.) thrust each can be carried. Rack can be dropped after rocket power is expended. Water injection systems are fitted to engines in B-47E and RB-47E and are installed in modernised B-47B's. All production B-47's have provision for flight re-fuelling, using Boeing "Flying Boom" system.

ACCOMMODATION.—Crew of three. Pilot and co-pilot in tandem under bubble-type canopy. Bombardier in nose. Ejection seats for all crew members, pilot and co-pilot ejected upwards and navigator downward under nose. Entire crew accommodation forward of wings pressurised and temperature-controlled.

ARMAMENT.—Remotely-controlled tail armament of two 20 mm. cannon. Designed internal bomb load 20,000 lb. (9,080 kg.). Can also be armed with GAM-63 Rascal air-to-surface missile.

DIMENSIONS.—
Span 116 ft. (35.4 m.).
Length 107 ft. (32.6 m.).
Height (over tail) 28 ft. (8.5 m.).

DESIGNED LOADED WEIGHT.—
200,000 lb. (90,800 kg.).

PERFORMANCE.—
Max. speed over 600 m.p.h. (960 km.h.).
Range (internal fuel) over 3,000 miles (4,830 km.).

THE BOEING STRATOCRUISER.

Stratocruisers were still being operated by Pan American World Airways, Northwest Airlines and British Overseas Airways in 1958.

Pan American World Airways have modified their fleet of Stratocruisers to obtain increased performance. The engines of all the 25 aircraft have been



A Boeing B-47 (YDB-47B) Stratojet carrying the Bell GAM-63 Rascal air-to-surface missile.



The Boeing KC-97G Tanker-Transport (four Pratt & Whitney R-4360 engines).

fitted with G.E. CH-10 turbo-superchargers, the slightly larger turbine wheels of which will permit the engines to develop another 50 h.p. each. Ten of these aircraft, operated by the company's Atlantic Division, have also been given increased fuel capacity in the outer wings to provide non-stop New York-London (or Paris) range, and are known by Pan American as "Super Stratocruisers." The remaining aircraft, operated by the Pacific-Alaska Division, do not need the increased range.

A full structural description and specification of the Stratocruiser has appeared in previous editions of "All the World's Aircraft."

THE BOEING STRATOFREIGHTER.
U.S. Air Force designation: C-97.

The C-97 Stratofreighter is the military transport counterpart of the Stratocruiser, from which it differs principally in the arrangement and equipment of the large two-deck fuselage. The XC-97 was, in fact, the forerunner of the civil Stratocruiser and all initial prototype trials of the civil airliner were conducted with the XC-97.

The principal structural modification to the C-97 fuselage involves the provision of large loading doors and an internally operated ramp under the rear fuselage to permit the loading of wheeled and tracked vehicles and other bulky cargo. An electrically-operated cargo hoist runs along the entire length of the fuselage. Three fully-loaded 1½-ton trucks or two light tanks can be driven into the fuselage, the drive-up ramp being raised and lowered by the cargo hoist. Adequate cargo handling and tie-down equipment is provided. The cabins can also be arranged to accommodate 134 fully-equipped troops, or be fitted out as a hospital transport for 83 stretcher cases and four attendants.

Three XC-97's were built and these were followed by ten YC-97's in three different versions of the basic design. These prototype and service test aircraft incorporated the wings, tail-unit, landing-gear and power-plant of the B-29. The C-97A and subsequent production versions use the main components of the B-50.

The 500th Stratofreighter—a KC-97G—was completed on February 8, 1954. The 888th and last KC-97 was wheeled out of the Renton plant on July 18, 1956, the same day on which the first jet-powered KC-135 emerged from the factory. The completion of the last KC-97 marked the end of Boeing's production of piston-engined aircraft.

The principal features of the many versions of the C-97 are given below.

C-97A. Four Pratt & Whitney R-4360-27 engines. First production aircraft delivered to U.S.A.F. on October 15, 1949. C-97A has a normal payload of 41,400 lb. (18,800 kg.) and under special conditions can carry up to 53,000 lb. (24,060 kg.). It can accommodate 134 fully-equipped troops or mixed loads of cargo or troops. As an ambulance it can transport 83 stretcher patients with medical supplies and attendants.

C-97C. Four 3,250 h.p. Pratt & Whitney R-4360-35A engines. Similar to C-97A in general details and performance. New flush-mounted radio antennae, heavier floor, higher payload. First production C-97C delivered to U.S.A.F. in February, 1951.

VC-97D. Three specially-modified C-97A's supplied to U.S.A.F. Strategic Air Command as mobile "command posts." Used as Staff Transports and living quarters for key personnel in overseas training missions.

KC-97E. Four 3,250 h.p. Pratt & Whitney R-4360-35A engines. Multi-purpose transport and tanker. Has permanent fixtures for tanker but can be rapidly converted to cargo or troop carrier, or ambulance. Pod carrying flying boom, operator and controls is detachable and tanks, pumps, etc. on upper deck are removable. First production KC-97E delivered to U.S.A.F. in July, 1951.

KC-97F. Four 3,250 h.p. Pratt & Whitney R-4360-59 engines. Convertible tanker-transport. Other details and performance similar to KC-97E.

KC-97G. Four 3,250 h.p. Pratt & Whitney R-4360-59B engines. Development of KC-97F. Change in location of refuelling tanks and related equipment, so that they need not be removed when aircraft is used as a transport. As a personnel carrier without refuelling equipment can carry 96 fully equipped combat troops, or as an ambulance, 69 stretcher patients, medical attendants and supplies. With refuelling equipment installed can carry 65 fully-equipped troops or 49 stretcher cases, attendants and supplies. Fitted with two external fuel tanks with total capacity for 1,400 U.S. gallons (5,290 litres). Pressurisation system maintains ground atmospheric pressure to 15,500 ft. (4,730 m.). Last KC-97G completed on July 18, 1956.

The particulars below refer specifically to the KC-97G.

DIMENSIONS.—
Span 141 ft. 3 in. (43.1 m.).
Length 110 ft. 4 in. (33.64 m.).
Height 38 ft. 3 in. (11.6 m.).

WEIGHTS.—
Weight empty 82,500 lb. (37,450 kg.).
Weight loaded 153,000 lb. (69,460 kg.).
Max. permissible loaded weight 175,000 lb. (79,450 kg.).
Landing weight 121,000 lb. (54,930 kg.).

PERFORMANCE.—
Max. speed 375 m.p.h. (600 km.h.).
Cruising speed 300 m.p.h. (480 km.h.).
Operating range 4,300 miles (6,880 km.).
Service ceiling over 35,000 ft. (10,675 m.).

THE BOEING BOMARC.
U.S.A.F. designation: IM-99.

Following a programme of test firings with 112 GAPA (Ground to Air Pilotless Aircraft) rockets in 1946-49, Boeing began work on a new pilotless interceptor missile at the invitation of the U.S. Air Force Material Command. Known originally as the F-99 Bomarc (Bo for Boeing, marc for Michigan Aeronautical Research Center, a University of Michigan agency which did early developmental work on the missile's ground guidance system) this weapon has now been re-designated the IM-99 (for Interceptor Missile).

Designed to intercept high-flying supersonic aircraft at distances of up to 250 miles from its firing point, Bomarc has an aircraft-type configuration and is powered in cruise conditions by two Marquardt ramjets mounted on struts under the fuselage. An Aerojet liquid-propellant rocket in its after fuselage boosts and accelerates the missile initially to the speed at which the ramjets can take over propulsion. In the advanced version of Bomarc, now in its late design stages, the rocket will be of the solid propellant type, giving the missile less weight and an ultimate range of over 400 miles (640 km.).

The first test firing in the Bomarc programme was made in the autumn of 1952 and since then a number of XIM-99 missiles have been fired successfully against target drones from Patrick AFB, Cape Canaveral Missile Test Center, Florida. Subsequent tests are scheduled for this year (1958) at Eglin AFB, Florida, with a service test batch of YIM-99 Bomarcs.

The U.S.A.F. has announced three production orders for the Bomarc weapons system which will be put into service by U.S. Air Defense Command. About 45 Bomarc bases will be needed for the protection of the continental United States.

It has also been announced that the Canadian Government has decided to adopt the Bomarc for northern defence.

Further specification details and an illustration of the IM-99A, the model currently in production, are given in the "Guided Missiles" section of this work.

BRANTLY

BRANTLY HELICOPTER CORPORATION.

HEAD OFFICE: 24 MAPLEWOOD AVE., PHILADELPHIA 44, PENNSYLVANIA.

WORKS: MUNICIPAL AIRPORT, FREDERICK, OKLAHOMA.

President: N. O. Brantly.
Secretary-Treasurer: E. K. Dawes.
General Manager: A. P. Hoover.

Brantly Helicopter Corporation was formed by Mr. N. O. Brantly, who designed a helicopter with co-axial rotors, known as the Model B-1, in 1943. This aircraft flew in 1946, but was too complex for a personal type helicopter.

Mr. Brantly then designed the Model B-2, using the rotor design from the B-1 which is distinctive in having coincident flapping and lag hinges at approximately 40% of the blade length. A second flapping hinge was added near the hub, to make the rotor suitable for a single-rotor configuration.

The prototype of the Brantly B-2 first flew on February 21, 1953 and had completed 130 hours flying by the autumn of 1956. A second prototype, incorporating various improvements, first flew on August 14, 1956, and is described in detail below.

The second B-2 was scheduled to complete its C.A.A. certification tests during 1958, and the company has started work on 15 production models, the first of which is due off the assembly line in January, 1959. They will include an evaluation batch of five YHO-3's for the U.S. Army.

Brantly is also developing a new twin-engined tandem-rotor helicopter known as the B-3, of which brief details follow.

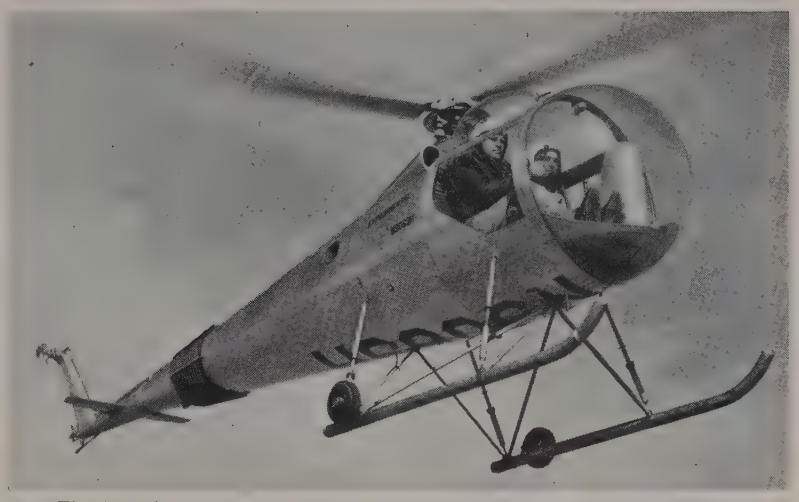
THE BRANTLY MODEL B-3.

The B-3 will be a twin-engined tandem-rotor helicopter using the proven engine-transmission-rotor system components of the B-2. It will accommodate four stretchers in the casualty evacuation rôle and will have a floor hatch for rescue operations. No further details are available except that it will have an empty weight of 2,000 lb. (907 kg.), loaded weight of 3,400 lb. (1,540 kg.) and cruising speed of 100 m.p.h. (161 km.h.).

THE BRANTLY MODEL B-2.

U.S. Army designation: YHO-3.

TYPE.—Two-seat Light helicopter.



The Brantly Model B-2 Helicopter (162 h.p. Lycoming VO-360 engine).

ROTOR SYSTEM.—Three-blade main rotor of all-metal construction, with articulated inboard flapping hinges offset 2.67 in. (67.8 mm.) from hub, and coincident flap and lag hinges offset 51.85 in. (1,317 mm.) from hub. Symmetrical blade section with 29% thickness ratio on inboard portion: NACA 0012 section outboard of hinge. Chord 8.84 in. (22.45 cm.) inboard portion: 8 in. (20.32 cm.) outboard portion. Blades attached to hub by flapping links. Conventional hub. Area of each main rotor blade 7.42 sq. ft. (0.69 m.²). Main rotor disc area 442 sq. ft. (41.06 m.²). Two-blade tail anti-torque rotor of all-metal construction. Disc area of tail rotor 13 sq. ft. (1.21 m.²).

ROTOR DRIVE.—Through centrifugal clutch and planetary reduction gears. Bevel gear take-off from main transmission with flexible coupling to tail rotor drive shaft. Main rotor/engine r.p.m. ratio 1 : 6.158. Anti-torque rotor/engine r.p.m. ratio 1 : 1.

FUSELAGE.—Stressed skin all-metal structure with conical tail section. Tail rotor now on swept-up boom extension.

LANDING GEAR.—Tubular skid type with small retractable wheels for ground handling. Fixed tail-skid. Oleo shock-absorbers with rubber disc taxying springs. Tyres 10 × 3½, pressure 60 lb./sq. in. (4.22 kg./cm.²). Skid track 5 ft. 8¼ in. (1.73 m.).

POWER PLANT.—One 162 h.p. Lycoming VO-360 A1A four-cylinder, horizontally-opposed air-cooled engine, mounted vertically, with induction cooling system. Fuel in two tanks, one under engine, capacity 22.5 U.S. gallons (85 litres), the other on port side of engine compartment, capacity 7.5 U.S. gallons (28 litres). Oil capacity 2 U.S. gallons (8.55 litres).

ACCOMMODATION.—Totally-enclosed cabin for two persons seated side-by-side. Doors are hinged on centre-line of cabin and open upwards. Dual controls. Compartment for 50 lb. (22.7 kg.) baggage in forward end of tail section.

DIMENSIONS.—
Diameter of main rotor 23 ft. 8⅞ in. (7.24 m.).
Diameter of tail rotor 4 ft. 3 in. (1.29 m.).
Length 21 ft. 9 in. (6.62 m.).
Overall width 6 ft. 5 in. (1.96 m.).
Height 11⅜ in. (2.13 m.).

WEIGHTS.—
Weight empty 960 lb. (435 kg.).
Weight loaded 1,600 lb. (726 kg.).

PERFORMANCE.—
Cruising speed 100 m.p.h. (161 km.h.).
Rate of climb at S/L 1,200 ft./min. (365 m./min.).
Rate of autorotative descent at S/L. 1,400 ft./min. (425 m./min.).
Range 270 miles (435 km.).

CALLAIR

THE CALL AIRCRAFT COMPANY.

HEAD OFFICE AND WORKS: AFTON, WYOMING.

Manager: Barlow H. Call.

The original CallAir Model A two-seat light cabin monoplane was flown in 1941 and put into production two years later. The latest developments of this type are the A-4 Models 150 and 180, and an agricultural version of the A-4 150 known as the A-4 Ag. Details of all three types are given hereafter.

THE CALLAIR A-4 MODEL 150.

The prototype of this aircraft flew for the first time on December 14, 1954, and was followed by the first production A-4 Model 150 on March 5, 1955.

TYPE.—Two/three-seat Cabin monoplane.

WINGS.—Braced low-wing monoplane. Modified Clark Y wing section. Aspect ratio 6.75. Chord 5 ft. 2¾ in. (1.59 m.). Dihedral 5° 8′. Incidence 0° 20′. Constant-chord structure with spruce wood spars, metal-covered leading-edge and fabric covering on remainder of wing. Multiple steel-tube bracing struts on each side of fuselage. Fiberglas end-plates at tips. Wooden ailerons are fabric-covered. No flaps. Total area of ailerons 11.8 sq. ft. (1.09 m.²). Gross wing area 186.1 sq. ft. (17.29 m.²).

FUSELAGE.—Steel-tube structure with fabric covering.

TAIL UNIT.—Wire-braced monoplane type. Steel-tube structure with fabric covering. Areas: fin 8.6 sq. ft. (0.80 m.²), rudder 8.4 sq. ft. (0.78 m.²), tailplane 15.8 sq. ft. (1.47 m.²), elevators 14.0 sq. ft. (1.30 m.²). Tailplane span 10 ft. 6½ in. (3.20 m.).

LANDING GEAR.—Non-retractable tail-wheel type. Callair oleo shock-absorbers. Main wheels Goodyear Type III size 6.00 × 6. Maule tail-wheel. Goodyear Spot-type hydraulic brakes. Wheel track 7 ft. 8½ in. (2.34 m.). Wheelbase 17 ft. 1 in. (5.21 m.).

POWER PLANT.—One 150 h.p. Lycoming O-320-A2A four-cylinder horizontally-opposed air-cooled engine driving a two-blade Sensenich Model M 74 DM fixed-pitch metal airscrew. Fuel in fuselage tank with capacity of 25 U.S. gallons (94.5 litres). Oil capacity 2 U.S. gallons (7.5 litres).

ACCOMMODATION.—Enclosed cabin seating two or three persons side-by-side. Seat is 43 in. (1.09 m.) wide with three belts. Access door on each side. Cabin heater.

DIMENSIONS.—
Span 35 ft. 5¼ in. (10.8 m.).
Length 23 ft. 9½ in. (7.25 m.).
Height 7 ft. 10 in. (2.38 m.).

WEIGHTS.—
Weight empty 1,000 lb. (454 kg.).
Weight loaded 2,150 lb. (975 kg.).

PERFORMANCE.—
Max. speed 104 m.p.h. (167 km.h.).
Cruising speed (75% power) 82 m.p.h. (132 km.h.).
Stalling speed, power on 51 m.p.h. (82 km.h.).
Stalling speed, power off 55 m.p.h. (88.5 km.h.).
Rate of climb at S/L 500 ft./min. (152 m./min.).
Service ceiling 17,000 ft. (5,180 m.).
Take-off distance 620 ft. (189 m.).
Landing distance 447 ft. (136 m.).
Range 260 miles (418 km.).

THE CALLAIR A-4 AG.

The CallAir A-4 Ag. aircraft is basically similar in layout and construction to the



The CallAir A-4 Duster-Sprayer (150 h.p. Lycoming O-320 engine).

A-4 Model 150, but has simplified structure and specialised equipment for agricultural duties.

Its two-seat open or enclosed cockpit is on the port side, with the dust hopper adjacent on the starboard side. Standard equipment includes a simplified instrument panel, turnover structure, B-11 safety belt and shoulder harness.

The wings have a reduced span compared with those of the A-4 Model 150. Oversize tyres and Goodyear disc brakes are standard.

There are four versions of the A-4 Ag., as follows :—

Standard A-4. Fiberglas dust hopper only, capacity 18 cub. ft. (0.51 m.³).

A-4 Duster. As standard A-4, with addition of spreader and hopper throat and door actuating mechanism.

A-4 Sprayer. As standard A-4, with addition of spray equipment, comprising Simplex wind-driven pump and booms constructed of $\frac{7}{8}$ in. (2.21 cm.) tubing with provision for mounting up to 48 Teejet nozzles. Simplex dump valve able to release 100 U.S. gallons (378 litres) of liquid in about 3 seconds.

A-4 Combination. As standard A-4, with both dust and spray dispensing gear.

All versions are fitted with one 150 h.p. Lycoming O-320-A2A four-cylinder horizontally-opposed air-cooled engine, driving a Sensenich two-blade fixed-pitch metal airscrew.

DIMENSIONS.—
Span 33 ft. 6 in. (10.21 m.).
Length 23 ft. 5⅜ in. (7.15 m.).
Height 7 ft. (2.13 m.).

WEIGHTS AND LOADINGS.—
Weight empty 975 lb. (442 kg.).
Disposable load 1,175 lb. (533 kg.).
Weight loaded 2,150 lb. (975 kg.).
Wing loading 11.94 lb./sq. ft. (58.3 kg./m.²).
Power loading 14.3 lb./h.p. (6.49 kg./h.p.).

PERFORMANCE.—
Cruising speed (75% power) 100 m.p.h. (161 km.h.).
Landing speed 43 m.p.h. (69 km.h.).
Rate of climb at S/L. 500 ft./min. (153 m./min.).
Service ceiling 17,000 ft. (5,180 m.).
Take-off distance 750 ft. (230 m.).
Landing distance 400 ft. (122 m.).
Range 350 miles (563 km.).

THE CALLAIR A-4 MODEL 180.

This aircraft, the prototype of which flew for the first time on December 18, 1957, is identical with the A-4 Model 150 except that it has a more powerful engine and increased fuel capacity.

POWER PLANT.—One 180 h.p. Lycoming O-360-C1A four-cylinder horizontally-opposed air-cooled engine, driving a McCauley Model 2D36C14 two-blade constant-speed metal airscrew or McCauley Model 1A170/GM two-blade fixed-pitch metal airscrew. Fuel in two tanks in wings, each with capacity of 20 U.S. gallons (75 litres). Oil capacity 2 U.S. gallons (7.5 litres).

DIMENSIONS.—
Same as A-4 Model 150, except :
Length 24 ft. 1 in. (7.34 m.).

WEIGHTS.—
Weight empty 1,135 lb. (515 kg.).
Weight loaded 2,350 lb. (1,066 kg.).

PERFORMANCE.—
Max. speed 107 m.p.h. (172 km.h.).
Cruising speed (75% power) 83 m.p.h. (133.5 km.h.).
Stalling speed, power on 51 m.p.h. (82 km.h.).
Stalling speed, power off 57 m.p.h. (92 km.h.).
Rate of climb at S/L 765 ft./min. (233 m./min.).
Service ceiling 17,000 ft. (5,180 m.).
Range 410 miles (660 km.).

CARMA

CARMA MANUFACTURING COMPANY.

HEAD OFFICE AND WORKS : 1,879 MULLIN AVENUE, TORRANCE, CALIFORNIA.

AIRCRAFT DIVISION : TUCSON, ARIZONA.

The Carma Manufacturing Company was established in 1948 to produce electrical and mechanical equipment and controls for aircraft.

An aircraft division was formed at Tucson, Arizona, in 1954 to manufacture the Weejet jet-trainer, a description of which follows.

THE CARMA WEEJET VT-1.

The Weejet was designed to C.A.A. trainer requirements and the prototype flew for the first time on March 30, 1956. It was later destroyed in a flying accident, but further Weejets are projected, incorporating minor changes. The following details apply to the developed version.

TYPE.—Two-seat jet Primary Trainer.

WINGS.—Mid-wing cantilever monoplane. NACA 23012 wing section. Aspect ratio 5.22. Mean chord 5 ft. 6 in. (1.68 m.). Incidence 2°. Aluminium alloy structure. All-metal ailerons and slotted flaps. Wing area 150 sq. ft. (13.94 m.²).

FUSELAGE.—Aluminium alloy semi-monocoque structure.

TAIL UNIT.—"Butterfly" type consisting of tailplane and elevators set at acute dihedral angle. Aluminium alloy structure. Total area of tail surfaces 45.5 sq. ft. (4.23 m.²).

LANDING GEAR.—Retractable tricycle type. Carma hydraulic shock-absorber struts. Electrical retraction. Goodyear wheels, tyres and brakes. Wheel track 10 ft. 2 in. (3.10 m.). Wheel base 8 ft. 8 in. (2.64 m.).



The Carma Weejet VT-1 Primary Trainer (Continental J69 turbojet engine).

POWER PLANT.—One Continental J69-T-9 turbojet engine supplying 920 lb. (417 kg.) s.t. at sea level. Fuel in two wing tanks with total capacity of 132 U.S. gallons (500 litres). Two auxiliary wing-tip tanks with total capacity of 100 U.S. gallons (378.5 litres) can be carried for ferrying. Oil capacity 2 U.S. gallons (7.5 litres).

ACCOMMODATION.—Pupil and instructor side-by-side in enclosed cabin. The two main transparent panels hinge upwards along the centre-line to give access to the cockpit. AN/ARC-27 command radio and AN/ARA-25 direction finder radio.

DIMENSIONS.—
Span 28 ft. (8.53 m.).
Length 24 ft. 6 in. (7.47 m.).
Height 6 ft. 8 in. (2.03 m.).

WEIGHTS AND LOADINGS.—
Weight empty 2,481 lb. (1,125 kg.).
Normal weight loaded 3,826 lb. (1,735 kg.).
Max. weight loaded 4,541 lb. (2,060 kg.).
Wing loading (normal) 25.5 lb./sq. ft. (124.5 kg./m.²).

PERFORMANCE (at 3,826 lb.=1,735 kg.).—
Max. speed at 15,000 ft. (4,570 m.) 334 m.p.h. (537 km.h.).
Cruising speed at 15,000 ft. (4,570 m.) 283 m.p.h. (456 km.h.).
Stalling speed at landing weight 64.5 m.p.h. (104 km.h.).
Rate of climb at S/L. 2,200 ft./min. (670 m./min.).
Time to 20,000 ft. (6,100 m.) 11.1 min.
Service ceiling 35,000 ft. (10,670 m.).
Take-off to 50 ft. (15.25 m.) 1,800 ft. (550 m.).
Endurance at S/L. 1.72 hr.

CESSNA

THE CESSNA AIRCRAFT COMPANY.

HEAD OFFICE AND WORKS : WICHITA, KANSAS.

Established : September 22, 1927.

President and General Manager : Dwane L. Wallace.

Vice-President and Treasurer : Frank A. Boettger.

Vice - President Engineering : Tom Salter.

Vice-President and General Manager, Commercial Aircraft Division : Del Roskam.

General Manager, Military Aircraft Division : Bob Lair.

General Manager, Industrial Products Division : Neil Whitney.

Secretary and Controller : Raymond G. Largent.

The Cessna Aircraft Company was founded by the late Clyde V. Cessna, a pioneer in U.S. aviation since 1911, and was incorporated in 1927. It marked its 30th anniversary in 1957 and has produced more than 30,000 aircraft since the company was founded.

The Company now has in production seven commercial aircraft for civilian use, including the Model 150, introduced in 1958 ; the Model 172, introduced late in 1955 ; the Model 175, introduced in March, 1958 ; Model 180, introduced in 1953 ; Model 182, introduced early in 1956 ; the Skylane, which appeared for the first time in January, 1958 ; and the twin-engined Model 310, which went into production late in 1954.

A new high-performance single-engined commercial aircraft, designated the Model 210, is under development, with first deliveries scheduled for late 1959.

Development of the four-engined Model 620 executive transport was abandoned in October, 1957, after a re-appraisal of the potential market.

Cessna is also producing the T-37A twin-engined jet trainer for the U.S.A.F. ; the L-19E observation and liaison aircraft for the U.S. Army ; and the L-27A administrative and light cargo twin-engined monoplane for the U.S.A.F. The company has delivered an evaluation quantity of the YH-41 Seneca helicopter to the U.S. Army.

Sub-contract work undertaken by Cessna includes production of tailplanes for the B-52, tailplanes, fins and rudders for the F-105 and assemblies for the Lockheed T-33.

In late 1957 the company was re-organised into three divisions with a management consisting of a seven-member executive committee. The new divisions include a commercial aircraft division, a military aircraft division and an industrial products division. The last-mentioned specialises in the manufacture of industrial and agricultural hydraulic cylinders and components.

THE CESSNA MODEL 318.

U.S.A.F. designation: T-37A.

Now in volume production, the T-37A is the first jet-trainer designed as such

from the start to be used by the U.S.A.F. The first prototype XT-37 made its first flight on October 12, 1954.

The 200th T-37 was completed on July 23, 1958, and new orders will keep the type in production well into 1959.

TYPE.—Two-seat Primary Trainer.

WINGS.—Low-wing cantilever monoplane. All-metal structure. Hydraulically-operated all-metal high-lift slotted flaps inboard of ailerons. Total area of ailerons 11.39 sq. ft. (1.06 m.²). Total area of flaps 15.10 sq. ft. (1.40 m.²). Wing area 183.9 sq. ft. (17.09 m.²).

FUSELAGE.—All-metal structure. Hydraulically-actuated speed brake, below forward part of fuselage in region of cockpit, extends to a maximum angle of 66°.

TAIL UNIT.—Cantilever monoplane type. All-metal structure. Fin integral with fuselage, tailplane mounted one-third of way up fin. Movable surfaces all have electrically-operated trim-tabs. Areas: fin 12.41 sq. ft. (1.15 m.²), rudder 6.24 sq. ft. (0.58 m.²), tailplane 31.45 sq. ft. (2.92 m.²), elevators 11.64 sq. ft. (1.08 m.²).

LANDING GEAR.—Retractable nose-wheel type. Hydraulic actuation. Steerable nose-wheel. Main tyres 20×4.4. Nose-wheel tyre 600×6. Wheel brakes operated by separate hydraulic system controlled by dual rudder and brake pedals.

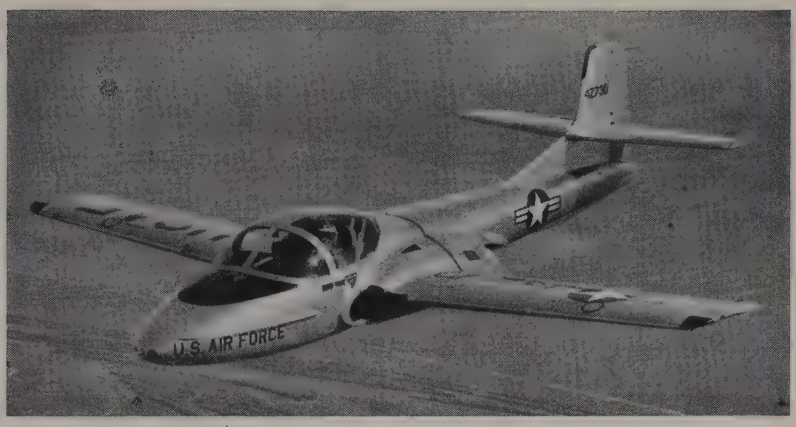
POWER PLANT.—Two Continental J69-T-9 turbojet engines each with 920 lb. (417 kg.) s.t. at 22,700 r.p.m. Air inlets and jet exits in thickened wing roots. Six rubber-cell inter-connected fuel tanks in wings feeding main tank in fuselage aft of cockpit. Total capacity 317 U.S. gallons (1,200 litres). Automatic fuel transfer by engine-driven pumps and submerged booster pumps.

ACCOMMODATION.—Enclosed cockpit seating two side-by-side with dual controls. Ejector seats and jettisonable clam-shell type canopy. Standardised cockpit lay-out, with flaps, speed brakes, trim-tabs, radio controls, etc. positioned and operated as in standard U.S.A.F. combat-type aircraft.

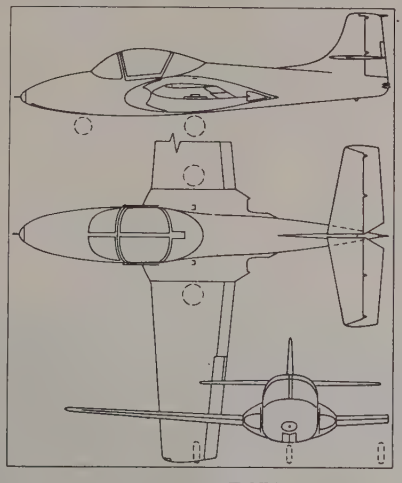
DIMENSIONS.—
Span 33 ft. 10 in. (10.3 m.).
Length 29 ft. 3 in. (8.93 m.).
Height 9 ft. 4 in. (2.85 m.).

WEIGHTS.—
Weight empty 3,890 lb. (1,766 kg.).
Weight loaded 6,400 lb. (2,903 kg.).

PERFORMANCE.—
Max. speed over 400 m.p.h. (644 km.h.).
Range over 575 miles (925 km.).



The Cessna T-37A Primary Trainer (two Continental J69 turbojet engines).



The Cessna T-37A.

THE CESSNA BIRD DOG.

U.S. Army designation: L-19.
U.S. Marine Corps designation: OE-1.

The Bird Dog was developed for the U.S. Army Field Forces as a light reconnaissance and observation aircraft, which could also be used for liaison and training duties. The first contract for 14 aircraft was placed in June, 1950, and subsequent large contracts have kept the L-19 in production, with deliveries scheduled to continue through 1958. More than 3,000 L-19's have been built since it first went into production.

The following versions have been produced for the U.S. Services :—

L-19A. Standard observation and liaison version for U.S. Army Field Forces.

XL-19B. One only. Fitted experimentally with 210 h.p. Boeing XT50 turboprop.

XL-19C. Two only. Fitted experimentally with Continental XT51 (Turbomeca Artouste) turboprop.

TL-19D. Instrument trainer with dual controls, comprehensive instruments and radio communication and navigation equipment.

L-19E. Current production version of standard observation and liaison aircraft.

OE-1. Similar to L-19A for U.S. Marine Corps.

In addition to its contracts for the U.S. Army, Cessna has built 90 L-19's for the French Government and has delivered others to the Canadian Government.

A licence to build the L-19 in Japan is held by Fuji Heavy Industries of Tokyo.

The L-19 seats a pilot and observer in tandem. A wide door, plus a push-out window and large rear cabin and baggage compartment, provide ample space for a standard stretcher, for which support brackets are fitted.



The Cessna TL-19D Instrument Trainer (213 h.p. Continental O-470 engine). (*Gordon Williams*).

The power-plant consists of a 213 h.p. Continental O-470-11 six-cylinder horizontally-opposed air-cooled engine. Fuel is carried in tanks built into the wings, with a capacity of 41 U.S. gallons (155 litres).

Electrically-operated flaps, developed by Cessna, are being fitted to all new production L-19's and to the earlier aircraft as th y pass through IRAN (Inspection, Repair as necessary) Modification Centers.

A winterisation kit has been developed by Cessna, which permits the L-19 to operate in temperatures as low as 60° below Zero. The equipment includes a 25,000 BThU heater, a collapsible 4-inch pre-heater hose, nose shutters, electric oil dilution unit, electric primer, internal de-frosters and a carburettor heater unit.

DIMENSIONS.—
Span 36 ft. (10.9 m.).
Length 25 ft. 10 in. (7.89 m.).
Height 7 ft. 4 in. (2.23 m.).

WEIGHTS AND LOADINGS (L-19E).—
Weight empty 1,614 lb. (680 kg.).



The Cessna L-19A (213 h.p. Continental O-470 engine).

Weight loaded (primary mission) 2,400 lb. (1,090 kg.).
Max. weight loaded (alternative missions) 2,430 lb. (1,103 kg.).
Wing loading 13.79 lb./sq. ft. (67.3 kg./m.²).
Power loading 11.26 lb./h.p. (5.11 kg./h.p.).

PERFORMANCE (L-19E).—
Max. speed 115 m.p.h. (184 km.h.).
Cruising speed (29% power) at 5,000 ft. (1,525 m.) 104 m.p.h. (166.4 km.h.).
Stalling speed 54 m.p.h. (86.4 km.h.).
Initial rate of climb 1,150 ft./min. (350 m./min.).
Service ceiling 18,500 ft. (5,640 m.).
Absolute ceiling 24,800 ft. (7,565 m.).
Cruising range 530 miles (848 km.).
Take-off over 50 ft. (15.25 m.) obstacle from grass 560 ft. (171 m.).
Landing from 50 ft. (15.25 m.) on grass 600 ft. (183 m.).

THE CESSNA MODEL 321.
U.S. Marine Corps designation: OE-2.

The Model 321 is a two-seat reconnaissance monoplane, of which 25 are in service with the U.S. Marine Corps.

Although similar in appearance to its predecessor, the OE-1, the OE-2 is a completely new aeroplane which exemplifies a new concept in liaison aircraft performance and equipment.

The OE-2 is powered by a 265 h.p. Continental O-470-2 supercharged engine.

Pilot and observer are protected against enemy fire by flak curtains and seat armour. The fuel tanks, which have a capacity of 52 U.S. gallons (197 litres), are semi-self-sealing.

Equipment includes specialised radio equipment for flexible communication with ground troops.



The Cessna OE-2 (265 h.p. Continental O-470-2 supercharged engine).



The Cessna Model 310B (two 240 h.p. Continental O-470 engines).

Other features which extend its versatility include its ability to carry a 250-lb. bomb or three rockets under each wing, a telephone wire-laying container, a chemical spray tank for laying smoke screens, or an aerial delivery containor for dropping supplies.

WEIGHT.—
Max. loaded weight 2,650 lb. (1,202 kg.).

PERFORMANCE.—
Max. speed 185 m.p.h. (298 km.h.).
Initial rate of climb 1,300 ft./min. (395 m./min.).
Rate of climb at 10,000 ft. (3,050 m.) 1,100 ft./min. (335 m./min.).
Time to 20,000 ft. (6,100 m.) 22.6 min.
Range at 10,000 ft. (3,050 m.) 575 miles (925 km.).

THE CESSNA MODEL 310B.
U.S.A.F. designation: L-27A.

The Model 310 is a twin-engined five-seat cabin monoplane, the prototype of which first flew on January 3, 1953. More than 700 have been built since the Model 310 went into production late in 1954.

An improved model, announced in July, 1957, is the Model 310B, with newly designed instrument panel, improved soundproofing, and improvements in cabin furnishing, lighting and equipment. The loaded weight of this version is 4,700 lb. (2,132 kg.).

The Cessna 310 was also chosen for service with the U.S.A.F. early in 1957, under the designation L-27A, as the result of a competition for a light twin-engined administrative liaison and cargo aircraft. The initial contract was for 80 aircraft. Early in 1958 an additional order was received from the U.S.A.F.

TYPE.—Twin-engined Five-seat Cabin monoplane.

WINGS.—Low-wing cantilever monoplane. All-metal flush-riveted structure. Electrically-operated split flaps between ailerons and fuselage. Maximum flap depression 45°. Wing area 175 sq. ft. (16.2 m.²).

FUSELAGE.—All-metal flush-riveted structure.

TAIL UNIT.—Cantilever monoplane type. All-metal flush-riveted structure. Trim-tabs in rudder and elevators.

LANDING GEAR.—Retractable nose-wheel type. Electro-mechanical retraction. Cessna type oleo shock-absorber struts. Nose-wheel steerable to 15° and castoring from 15° to 55° in both directions.

POWER PLANT.—Two 240 h.p. Continental O-470-M six-cylinder horizontally-opposed air-cooled engines. Each engine exhausts into two stainless steel augmenter tubes terminating above wing ahead of trailing-edge. Two-blade metal constant-speed full-feathering airscrews. Fuel in two permanently-attached wing-tip tanks, each of which contains a bladder-type fuel cell holding 50 U.S. gallons (189 litres). Cross-feed fuel system. Each wing tank is also fitted with an electrical fuel boost pump. An optional 30 U.S. gallon (113 litres) auxiliary fuel system became available during 1956. It consists of two 15 U.S. gallon (56.5 litres) rubber fuel cells which are installed between the wing spars outboard of each engine nacelle and connected to the main fuel system. Total extra weight of the auxiliary fuel system is only 16 lb. (7.25 kg.). Oil capacity 6 U.S. gallons (22.7 litres).

ACCOMMODATION.—Cabin seats five, two in front and three on cross bench behind. Controlled heating provided by Stewart-Warner thermostatically-controlled blower-type heater. Large door on starboard side giving access to all seats. Baggage compartment aft of cabin with internal and external access. Baggage capacity 200 lb. (91 kg.).

DIMENSIONS.—
Span 36 ft. (11.0 m.).
Length 27 ft. 1 in. (8.26 m.).
Height 10 ft. 5 in. (3.17 m.).

WEIGHTS AND LOADINGS (Model 310).—
Weight empty 2,900 lb. (1,315 kg.).
Weight loaded (5 people, max. fuel and oil 225 lb.=102 kg. baggage and optional equipment) 4,600 lb. (2,088 kg.).
Wing loading 26.2 lb./sq. ft. (127.7 kg./m.²).
Power loading 9.6 lb./h.p. (4.35 kg./h.p.).

WEIGHT (Model 310B).—
Max. loaded weight 4,700 lb. (2,132 kg.).

PERFORMANCE (Model 310B at 4,700 lb.= 2,132 kg. A.U.W.).—
Max. speed at S/L 232 m.p.h. (373 km.h.).
Cruising speed (70% power) at 8,000 ft. (2,440 m.) 213 m.p.h. (343 km.h.).
Rate of climb at S/L 1,660 ft./min. (505 m./min.).
Rate of climb on one engine at S/L 415 ft./min. (126 m./min.).
Service ceiling 20,500 ft. (6,250 m.).
Service ceiling on one engine 7,750 ft. (2,360 m.).
Cruising range (70% power) at 8,000 ft. (2,440 m.) 850 miles (1,368 km.).
Cruising range at 169 m.p.h. (272 km.h.) at 10,000 ft. (3,050 m.) 975 miles (1,570 km.).
Cruising range with auxiliary tanks (70% power) 1,107 miles (1,782 km.).



The Cessna L-27A, the military version of the Model 310.

THE CESSNA MODEL 210.

Cessna announced in July, 1958 the development of a new advanced single-engined aircraft designated the Model 210, which will be available for the commercial market in late 1959.

Although the prototype had been flying for some time, no details were released except that it will fit into the Cessna range between the Skylane and the Model 310B and will incorporate design features not found previously in aircraft of this category.

THE CESSNA MODEL 150.

The Model 150 is a new two-seat version of the familiar Cessna high-wing monoplane which has been designed to meet the needs for a modern dual-control trainer or light touring or commuting aircraft. It was placed on the market in October, 1958, backed by orders for 600 placed by the 38 agencies forming Cessna's domestic distributor organisation, plus a further 115 earmarked for the company's own export sales organisation.

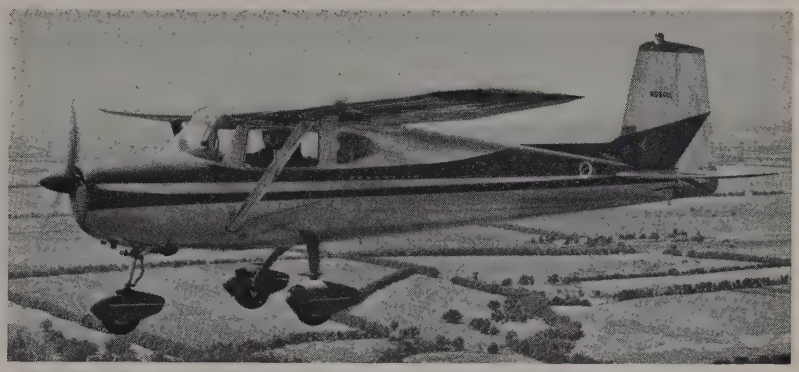
TYPE.—Two-seat cabin monoplane.

WINGS.—High-wing braced monoplane. Structure similar to 172. Total flap area 17.24 sq. ft. (1.60 m.²). Total aileron area 17.88 sq. ft. (1.66 m.²). Gross wing area 160 sq. ft. (14.86 m.²).

FUSELAGE.—All-metal monocoque.

TAIL UNIT.—Cantilever monoplane type. All-metal structure.

LANDING GEAR.—Fixed tricycle type. "Land-o-Matic" gear as fitted to 172 and 182. Goodyear gear-toothed individually-



The Cessna Model 150 (100 h.p. Continental O-200-A engine).

gear. It was introduced in November, 1955 and more than 1,100 Model 172's were delivered during the first year's production.

TYPE.—Four-seat Cabin monoplane.

WINGS.—High-wing braced monoplane. NACA 2412 wing section. Aspect ratio 7.46. Dihedral 2° 8′. All-metal single-spar structure with metal skin. Single bracing strut on each side. NACA slotted flaps inboard of ailerons. Aileron area (total) 18.3 sq. ft. (1.70 m.²). Total flap area 21.23 sq. ft. (1.97 m.²). Gross wing area 174 sq. ft. (16.2 m.²).

FUSELAGE.—All-metal monocoque.

TAIL UNIT.—Cantilever monoplane type. All-metal structure. Horn-balanced rudder

DIMENSIONS.—
- Span 36 ft. (10.9 m.).
- Length 25 ft. (7.62 m.).
- Height 8 ft. 6 in. (2.59 m.).

WEIGHTS AND LOADINGS.—
- Weight empty 1,260 lb. (572 kg.).
- Weight loaded 2,200 lb. (1,000 kg.).
- Wing loading 12.6 lb./sq. ft. (61.48 kg./m.²).
- Power loading 15.2 lb./h.p. (6.9 kg./h.p.).

PERFORMANCE.—
- Max. speed 135 m.p.h. (217 km.h.).
- Max. recommended cruising speed 124 m.p.h. (199 km.h.).
- Stalling speed 52 m.p.h. (83 km.h.).
- Initial rate of climb 660 ft./min. (200 m./min.).
- Service ceiling 13,300 ft. (4,050 m.).
- Endurance at max. recommended cruising speed 4.2 hours.

THE CESSNA MODEL 175.

The Model 175 is similar in configuration to the Model 172. It is powered by a Continental GO-300-A geared engine, and has a number of design and equipment refinements, including a free-blown wind-shield, new panel design, inside fuel drain, electric fuel gauges, Fiberglas speed fairings, and new interior and exterior styling. The aircraft is approved for the fitting of floats.

DIMENSIONS.—
- Same as for Model 172.

WEIGHTS AND LOADINGS.—
- Weight empty 1,312 lb. (596 kg.).
- Weight loaded 2,350 lb. (1,067 kg.).
- Wing loading 13.4 lb./sq. ft. (65.39 kg./m.²).
- Power loading 13.4 lb./h.p. (6.08 kg./h.p.).

PERFORMANCE.—
- Max. speed 147 m.p.h. (235 km.h.).
- Max. recommended cruising speed 139 m.p.h. (222 km.h.).
- Initial rate of climb 850 ft./min. (259 m./min.).
- Service ceiling 15,900 ft. (4,850 m.).
- Max. range at 102 m.p.h. (163 km.h.) 720 miles (1,150 km.).
- Cruising endurance 4.3 hours.



The Cessna Model 172 (145 h.p. Continental O-300-A engine).

operated toe-brakes on main wheels for pilot only in standard version, but for both occupants in trainer and commuter versions. Nylon tubeless tyres of same size on all three wheels. Track 6 ft. 5 in. (1.95 m.).

POWER PLANT.—One 100 h.p. Continental O-200-A four-cylinder horizontally-opposed air-cooled engine. All-metal two-blade Sensenich M69CK-52 fixed-pitch airscrew. All-metal fuel tanks in wings. Total fuel capacity 26 U.S. gallons (98 litres). Oil capacity 1.25 U.S. gallons (4.7 litres).

ACCOMMODATION.—Enclosed cabin seating two side-by-side. Dual controls standard in trainer version only, optional in other models. Baggage compartment behind seats, backs of which hinge forward for access.

DIMENSIONS.—
- Span 33 ft. 4 in. (10.2 m.).
- Length 21 ft. (6.4 m.).
- Height 6 ft. 11 in. (2.1 m.).

WEIGHTS AND LOADINGS.—
- Weight empty 962 lb. (437 kg.).
- Weight loaded 1,500 lb. (681 kg.).
- Wing loading 9.4 lb./sq. ft. (45.8 kg./m.²).
- Power loading 15 lb./h.p. (6.81 kg./h.p.).

PERFORMANCE (at max. A.U.W.).—
- Max. speed at S/L. 124 m.p.h. (200 km.h.).
- Max. recommended cruising speed (70% power at 9,000 ft.=2,745 m.) 121 m.p.h. (194 km.h.).
- Rate of climb at S/L. 740 ft./min. (226 m/min.).
- Service ceiling 15,300 ft. (4,670 m.).
- Range at max. recommended cruise (no allowance) 520 miles (832 km.).
- Max. range (43% power at 10,000 ft.=3,050 m.) 630 miles (1,008 km.).

THE CESSNA MODEL 172.

The Model 172 is similar to the earlier Model 170, which it superseded in production, except for its tricycle landing

and elevators. Areas: fin 9.0 sq. ft. (0.84 m.²), rudder 9.42 sq. ft. (0.87 m.²), elevators (total) 15.42 sq. ft. (1.43 m.²), tailplane 19.80 sq. ft. (1.84 m.²).

LANDING GEAR.—Cessna "Land-o-Matic" gear. Hydraulic wheel brakes. Nose-wheel is steerable with rudder up to 10° and controllable up to 30° on either side.

POWER PLANT.—One 145 h.p. Continental O-300-A six-cylinder horizontally-opposed air-cooled engine. McCauley two-blade metal airscrew. Fuel tanks in wings with total capacity of 42 U.S. gallons (159 litres).

ACCOMMODATION.—Cabin seats four in two pairs, front pair with dual controls. Baggage space aft of rear seats. 36-inch wide door on each side of cabin giving access to all seats and to simplify loading if rear seats removed and cabin used for freight. Combined heating and ventilation system. Fiberglas soundproofing.

THE CESSNA MODEL 180.

The Model 180 is generally similar in layout and construction to the Model 172, but has a Cessna patented tail-wheel type landing gear, the main units of which are cantilever legs of chrome-vanadium spring steel fitted with castoring wheels. Hydraulic brakes are fitted to the main wheels, which have a track of 7 ft. 6½ in. (2.29 m.) and wheel fairings are optional. A steerable, fully-swivelling tail-wheel is fitted.



The Cessna Model 175 (145 h.p. Continental GO-300-A engine).



The Cessna Model 180 (230 h.p. Continental O-470-K engine).



The Cessna Model 182 (230 h.p. Continental O-470-L engine).



The Cessna Skylane (230 h.p. Continental O-470-L engine).

Alternatively, the Model 180 can be fitted with Edo Model 2000 floats, amphibious floats or skis.

A four-seater, the Model 180 is powered with a 230 h.p. Continental O-470-K engine driving an all-metal constant-speed airscrew. It has an outside luggage door.

DIMENSIONS.—
Span 36 ft. (10.9 m.).
Length 26 ft. 2 in. (7.9 m.).
Height 7 ft. 6 in. (2.28 m.).

WEIGHTS AND LOADINGS.—
Weight empty 1,555 lb. (705 kg.).
Weight loaded 2,650 lb. (1,202 kg.).
Wing loading 15.1 lb./sq. ft. (73.6 kg./m.²).
Power loading 11.5 lb./h.p. (5.22 kg./h.p.).

PERFORMANCE.—
Max. speed 170 m.p.h. (274 km.h.).
Max. recommended cruising speed 160 m.p.h. (257 km.h.).
Initial rate of climb 1,130 ft./min. (336 m./min.).
Service ceiling 21,500 ft. (6,550 m.).
Max. range at 120 m.p.h. (193 km.h.) 845 miles (1,360 km.).
Endurance (cruising) 4.2 hours.

THE CESSNA MODEL 182.

First announced in March, 1956, the Model 182 is basically a Model 180 with a nose-wheel undercarriage, 230 h.p. Continental O-470-L engine and new "Flair Flight" features. The latter include single-action hand parking brake, external luggage door, redesigned seats, wheel fairings, rudder trim device, lighting console, styling and other refinements.

DIMENSIONS.—
Span 36 ft. (10.9 m.).
Length 26 ft. (7.9 m.).
Height 8 ft. 6 in. (2.59 m.).

WEIGHTS AND LOADINGS.—
Weight empty 1,560 lb. (708 kg.).
Weight loaded 2,650 lb. (1,202 kg.).
Wing loading 15.1 lb./sq. ft. (73.7 kg./m.²).
Power loading 11.5 lb./h.p. (5.22 kg./h.p.).

PERFORMANCE.—
Max. speed 165 m.p.h. (265 km.h.).
Max. recommended cruising speed 155 m.p.h. (249 km.h.).
Initial rate of climb 1,030 ft./min. (315 m./min.).
Service ceiling 19,800 ft. (6,035 m.).
Max. range at 114 m.p.h. (183 km.h.) 805 miles (1,295 km.).
Endurance (with 65 U.S. gallons=245 litres) over 4.2 hours.

THE CESSNA SKYLANE.

The Skylane is a *de luxe* version of the Model 182 and was first introduced in January, 1958. Special features include a full instrument panel, fitted with turn-and-bank and rate-of-climb indicators, sensitive altimeter, directional and horizontal gyros, clock, outside air temperature gauge, etc., sun visors, navigation light flasher, tinted windshield and windows, rudder trim, Fiberglas speed fairings and tow-bar. The Skylane also features an overall three-colour paint finish with over 500 different combinations available.

DIMENSIONS.—
Same as for Model 182.

WEIGHTS AND LOADINGS.—
Same as for Model 182.

PERFORMANCE.—
Max. speed 168 m.p.h. (268.8 km.h.).
Max. recommended cruising speed 158 m.p.h. (252.8 km.h.).
Max. range at 116 m.p.h. (186 km.h.) 819 miles (1,310 km.).
Other figures as for Model 182.

THE CESSNA CH-1B HELICOPTER.
U.S. Army designation: YH-41 Seneca.

Cessna entered the helicopter field following its acquisition of the Seibel Helicopter Company in 1952. Charles Seibel continues as chief engineer of the company's helicopter department.

Work on Cessna's first helicopter began in the Summer of 1952. Following wind-tunnel tests, a flying test-bed to prove the control and transmission system was built and this test vehicle first flew in July, 1953. It was developed into the CH-1 which flew for the first time in July, 1954.

Further development resulted in the CH-1B, of which the U.S. Army has taken delivery of an evaluation series of ten under the name of YH-41 Seneca.

The two most notable features of the CH-1B are the method of blade attachment to the main rotor hub, by means of flexible steel sheet L-section hinges which permit continuously-varying pitch of the blades without the need for pitch-change bearings; and the positioning of the engine in the nose of the fuselage, leaving greater passenger and/or cargo space near the C.G., and providing for better cooling and easier engine accessibility. The transmission system is also



The Cessna YH-41 Seneca Helicopter (270 h.p. Continental FSO-526-A engine).

a simplified one, there being only three gears in the main transmission and two in the tail rotor assembly.

The CH-1B, which employs a two-blade main rotor and a conventional two-blade anti-torque rotor, is of all-metal construction and is powered by a Continental FSO-526-A supercharged fan-cooled engine which delivers 270 net h.p. to the transmission. The cabin seats four persons in two pairs.

On December 28, 1957, Capt. J. E. Bowman, U.S.A.F., set up three International helicopter height records with a YH-41, reaching heights of 30,355 ft. (9,257 m.) in two weight categories and 28,200 ft. (8,601 m.) in a third weight category.

DIMENSIONS.—
Diameter of main rotor 35 ft. (9.30 m.).
Diameter of tail rotor 7 ft. (2.13 m.).
Fuselage length 32 ft. 8 in. (9.95 m.).
Fuselage width 5 ft. 4 in. (1.62 m.).
Height to top of cabin 7 ft. 1¾ in. (2.18 m.).
Overall length (main rotor fore and aft) 42 ft. 8 in. (13.0 m.)
Overall height 8 ft. 5 in. (2.57 m.).

WEIGHTS AND LOADINGS.—
Weight empty 2,050 lb. (930 kg.).
Disposable load 950 lb. (430 kg.).
Weight loaded 3,000 lb. (1,360 kg.).
Disc loading 3.12 lb./sq. ft. (15.22 kg./m.²).
Power loading 11.1 lb./h.p. (5.04 kg./h.p.).

PERFORMANCE (at 3,000 lb.=1,360 kg. A.U.W.).—
Max. speed at S/L 122 m.p.h. (195 km.h.).
Cruising speed 100-120 m.p.h. (160-192 km.h.).
Rate of climb at S/L 1,030 ft./min. (314 m./min.).
Climb to 10,000 ft. (3,050 m.) 11 min. 19 sec.
Hovering ceiling 14,500 ft. (4,420 m.).
Cruising range 267 miles (427 km.).
Endurance 3.3 hours.

CHAMPION

CHAMPION AIRCRAFT CORPORATION.

HEAD OFFICE AND WORKS: OSCEOLA, WISCONSIN.

President: Robert Brown.

Vice-President in charge of Production: Henry Dickhudt.

The Champion Aircraft Corpn. was formed by Flyers Service, Inc. to build and market the Model 7 Champion light two-seat training and agricultural monoplane, the manufacturing rights of which were bought from the Aeronca Manufacturing Corporation in June, 1954.

Production of the Champion Model 7EC by Champion Aircraft began in late 1954 and the first aircraft came off the assembly line in February, 1955.

It has now been joined in production by the Champion Model 7FC, which is generally similar except that it has a tricycle landing gear instead of the tail-wheel type of the Model 7EC.



The Champion Model 7FC Tri-Traveler (95 h.p. Continental C90 engine).

THE CHAMPION MODEL 7EC TRAVELER.

The Model 7 Champion was designed originally by Aeronca, who built over 10,000 of these aircraft between 1946 and 1951.

There are two versions of the Model 7EC. The standard version is known as the Traveler; while the Traveler Deluxe has a more luxuriously-furnished cabin.

TYPE.—Two-seat light cabin monoplane.

WINGS.—High-wing braced monoplane. NACA 4412 wing section. Aspect ratio 7.25. Chord 5 ft. (1.52 m.). Dihedral 2°. Incidence 1°. Two wood spars, aluminium ribs, fabric covering. Steel tube Vee bracing struts. Single-spar fabric-covered metal ailerons. No flaps. Total aileron area 12 sq. ft. (1.12 m.²). Gross wing area 170.22 sq. ft. (15.81 m.²).

FUSELAGE. — Welded chrome - molybdenum steel tube structure covered with fabric.

TAIL UNIT.—Wire-braced monoplane type. Tubular welded steel frames, fabric covering. Areas: fin 6.0 sq. ft. (0.55 m.²), rudder 6.8 sq. ft. (0.63 m.²), tailplane 14.08 sq. ft. (1.31 m.²), elevators 11.92 sq. ft. (1.11 m.²). Tailplane span 10 ft. 2¼ in. (3.12 m.).

LANDING GEAR.—Fixed divided-axle type. Oleo shock-absorber struts. Cleveland Model C-38500 wheels and Model C-7000 brakes. Steerable tail-wheel. Track 5 ft. 10 in. (1.78 m.).

POWER PLANT.—One 95 h.p. Continental C90-12F flat-four air-cooled engine driving McCauley (Met-L-Prop) Type IB90CM metal airscrew. Fuel in two 13 U.S. gallon (49 litres) wing tanks. Total fuel capacity 26 U.S. gallons (98 litres). Oil capacity 5 U.S. quarts (4.72 litres).

ACCOMMODATION.—Enclosed cabin seating two in tandem with dual controls. One-piece wrap-round windshield. Tinted transparent panels over baggage compartment, which accommodates 50 lb. (23 kg.) of luggage. Traveler Deluxe has foam seat cushions, floor carpeting, upholstered side panels, heater and air conditioning.

DIMENSIONS.—
Span 35 ft. 2 in. (10.72 m.).
Length 21 ft. 6 in. (6.56 m.).
Height (tail down) 7 ft. 2 in. (2.18 m.).

WEIGHTS.—
Weight empty 860 lb. (390 kg.).
Max. permissible loaded weight 1,450 lb. (658 kg.).

PERFORMANCE.—
Max speed 135 m.p.h. (216 km.h.).
Cruising speed 100 m.p.h. (160 km.h.).
Stalling speed (power on) 40 m.p.h. (64 km.h.).
Stalling speed (power off) 44 m.p.h. (70.4 km.h.).
Rate of climb at S/L. 800 ft./min. (244 m./min.).

THE CHAMPION MODEL 7FC TRI-TRAVELER.

The Champion Model 7FC is similar to the previously-described Model 7EC Traveler Deluxe in every respect, except that it has a tricycle landing gear. The first production Model 7FC flew in February, 1957.

DIMENSIONS.—
Same as for Model 7EC except:—
Height 8 ft. (2.44 m.).

WEIGHTS.—
Weight empty 910 lb. (413 kg.).
Weight loaded 1,500 lb. (680 kg.).

PERFORMANCE.—
Same as for Model 7EC except:—
Cruising speed 105 m.p.h. (169 km.h.).
Take-off distance 250 ft. (76 m.).

CHANCE VOUGHT

CHANCE VOUGHT AIRCRAFT, INC.

HEAD OFFICE AND WORKS: DALLAS, TEXAS.

Chairman of the Board: C. J. McCarthy.

President: F. O. Detweiler.

Senior Vice-President: H. B. Sallada.

Vice-President, Engineering: R. C. Blaylock.

Vice-President, Production: G. K. Johnson.

Vice-President and Controller: C. E. Burt.

Vice-President, Sales and Service: W. P. Thayer.

Assistant to President: Keith Baker.

Treasurer: B. W. Whitten.

Secretary: J. J. Gaffney.

Chief Engineer—Aircraft Projects: J. Russell Clark.

Chief Engineer—Missile Projects: S. O. Perry.

Chance Vought's current production aircraft is the Crusader supersonic naval fighter, of which the initial F8U-1 version has been in service with the U.S. Navy since March, 1957.

During 1958, Chance Vought produced prototypes of the F8U-2, an improved version of the F8U-1 with more powerful engine, and the F8U-3 all-weather fighter of completely re-engineered design. The F8U-3 is designed to intercept enemy bombers under any weather conditions at more than twice the speed of sound. It is scheduled for delivery to the U.S. Navy by 1960.

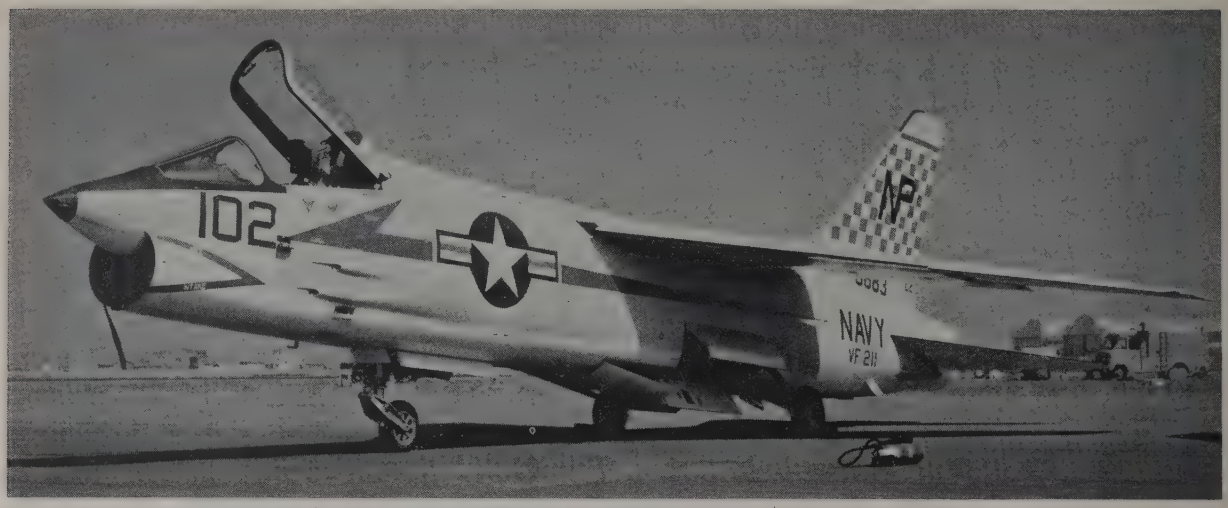
Chance Vought continued production of the Regulus I and II surface-to-surface missiles during 1958. A description of each appears in the "Guided Missiles" section of this work.

THE CHANCE VOUGHT CRUSADER.

U.S. Navy designation: F8U.

Chance Vought was given a development contract for the F8U in May, 1953 after winning a design competition in which eight airframe manufacturers had participated. The prototype XF8U-1 Crusader flew for the first time on March 25, 1955, exceeding the speed of sound in level flight. The first production F8U-1 flew on September 20, 1955 and, following successful completion of the Fleet Introduction Programme, the F8U-1 began reaching U.S. Naval operational squadrons in March, 1957. Navy Squadron VF-32, based at Cecil Field, Florida, was the first fighter unit to be equipped with the Crusader and the first to deploy this aircraft on board a carrier for foreign service, arriving in the Mediterranean in February, 1958.

On August 21, 1956, an F8U-1 set up the first U.S. national speed record of over 1,000 m.p.h. (1,600 km.h.). Operating under restrictions, it recorded a speed of 1,015.428 m.p.h. (1,634.17 km.h.). On July 16, 1957, an F8U-1P photo-reconnaissance version of the Crusader set up the first supersonic U.S. transcontinental record by flying the 2,445.9 miles (3,936 km.) from Los Angeles to New York in 3 hr. 22 min. 50 sec., at an average speed of 723.52 m.p.h. (1,164.39 km.h.), equivalent to an average of Mach 1.1 at 35,000 ft. (10,670 m.). The F8U-1P was refuelled in flight by AJ-2 Savage tankers, requiring it to descend to 25,000 ft. (7,620 m.) and reduce speed to under 300 m.p.h. (480 km.h.) on each occasion.



The Chance Vought F8U-1 Crusader Carrier Fighter (Pratt & Whitney J57 turbojet engine). (*Clay Janssen*).

An outstanding feature of the F8U is its two-position variable-incidence wing. This provides a high angle of attack for take-off and landing, while permitting the fuselage to remain almost parallel to a flight deck or runway for good pilot visibility.

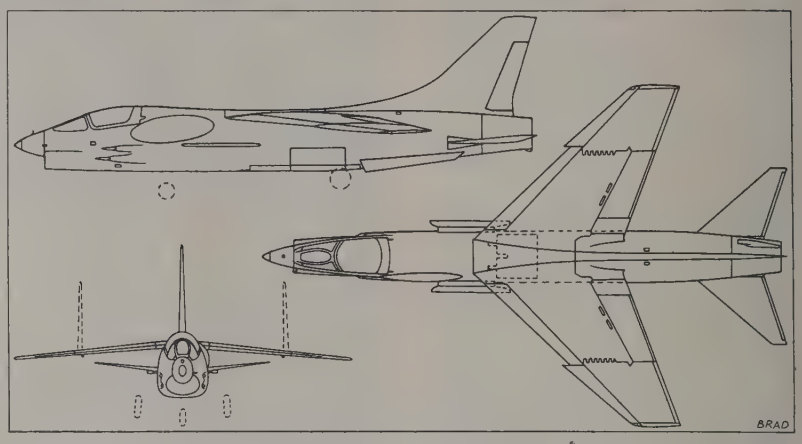
The following versions of the F8U have been mentioned :—

XF8U-1. Prototype with Pratt & Whitney J57-P-11 turbojet.

F8U-1. First production version. Brief description below refers to this version.

F8U-1P. Photographic-reconnaissance version of -1 which first flew late in 1956. Equipped with three CAX-12 trimetrogen cameras and two K-17 vertical cameras. Capable also of special mapping and charting missions, and night reconnaissance. Fuselage undersurface slightly squared around camera bay. In production.

F8U-2. Improved version of F8U-1 with Pratt & Whitney J57-P-16 turbojet, giving higher performance, particularly at altitude. F8U-2 has improved fire control system and additional radar capabilities. Its armament is the same as that of the F8U-1. Externally the two types are similar, except that the F8U-2 has two fixed ventral fins under the tail section and two afterburner airscoops mounted on the tail-cone above the tailplane. First prototype, flown in December, 1957, had the new engine only. Second prototype, flown in January, 1958, was representative of production aircraft, the first of which flew for the first time on August 20, 1958.



The Chance Vought F8U-2 Crusader.

The brief details below refer specifically to the F8U-1, but apply basically to the F8U-1P and F8U-2, except for differences detailed above.

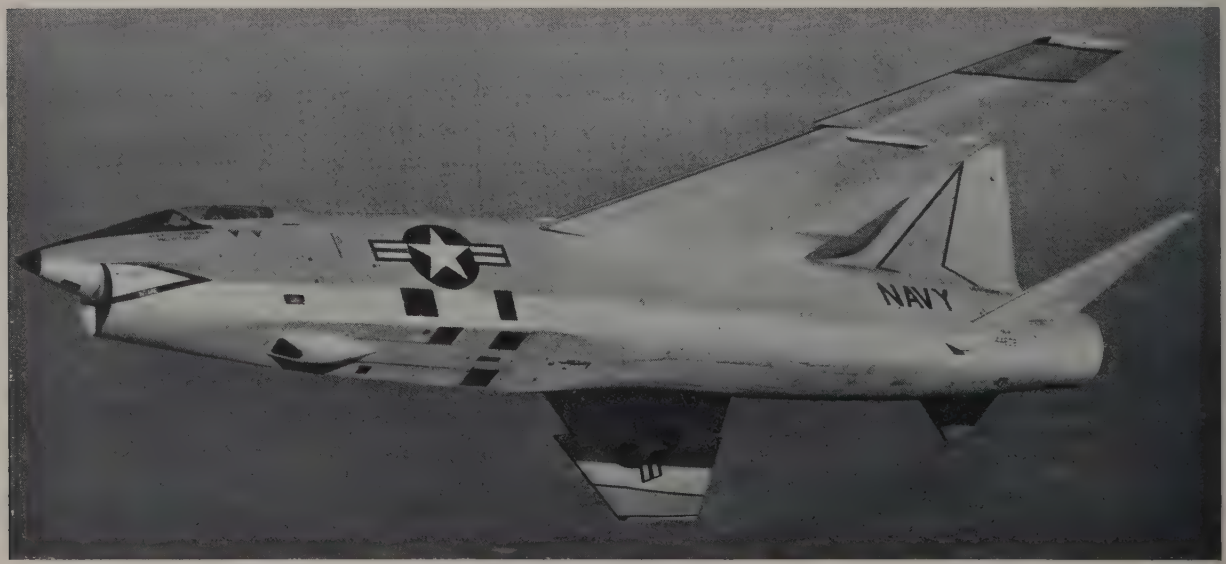
TYPE.—Supersonic single-seat Carrier Fighter.

WINGS.—Cantilever swept-wing monoplane. Thin laminar-flow section. Anhedral 5°. Wing is adjustable to two incidence positions by Aero-products hydraulic self-locking actuator. When wing is raised, the ailerons, a section of the flaps and the leading-edge are all drooped 20° automatically. Outer wing sections fold upwards for carrier stowage. All-metal multi-spar structure with sculptured aluminium-alloy upper and lower skins. Drooping "dog-tooth" leading-edges. Alvminium ailerons. Magnesium-alloy flaps.

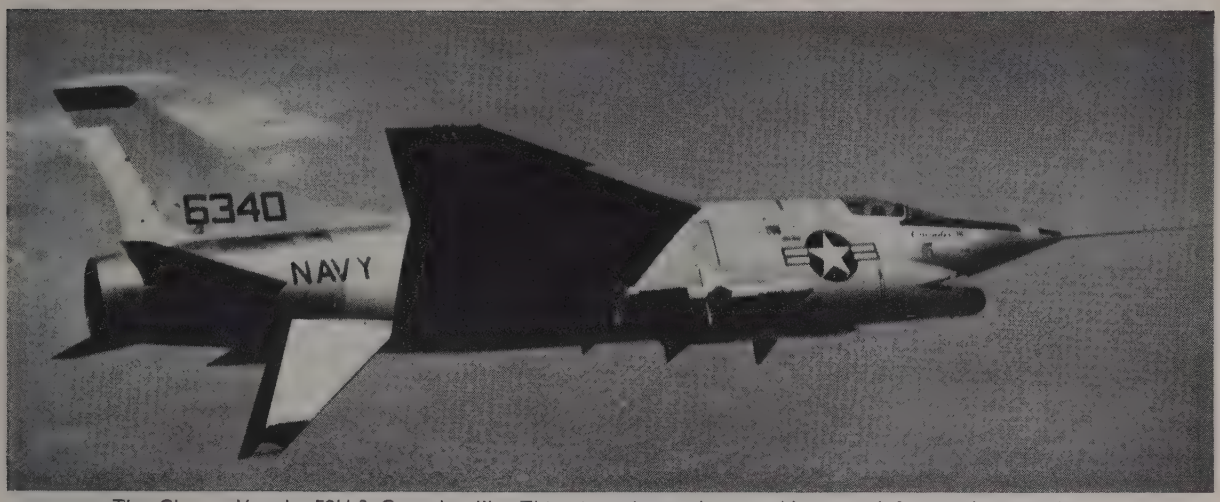
FUSELAGE.—All-metal structure in three main assemblies. Both magnesium-alloy and titanium are used in structure, the after section and a portion of the mid-section being of titanium, while 25 per cent of wing and fuselage skins are of magnesium.

TAIL UNIT.—Large swept vertical fin and rudder and powered one-piece horizontal "slab" tail. Tailplane span 18 ft. 2 in. (5.54 m.).

LANDING GEAR.—Retractable tricycle type with all wheels retracting into fuselage. Hydraulic actuation. Wheel track 9 ft. 8 in. (2.94 m.).



The Chance Vought F8U-1P, Photographic-reconnaissance version of the Crusader.



The Chance Vought F8U-3 Crusader III. This view shows the movable ventral fins in their maximum downward position.

POWER PLANT.—Initial aircraft with Pratt & Whitney J57-P-12 turbojet. Later and current aircraft have J57-P-4A turbojet with afterburner (16,000 lb. = 7,257 kg. s.t.). Integral fuel tanks in wings inboard of wing fold. Other tankage in fuselage. Provision for in-flight refuelling, with retractable probe housed in removable pack on port side of fuselage of F8U-1 and inside flush panel on F8U-1P.

ACCOMMODATION.—Pressurised cockpit in nose of fuselage with good forward and downward visibility. Lightweight ejector seat (30 lb. = 13.6 kg.). Liquid oxygen equipment.

ARMAMENT.—Four 20 mm. cannon in fuselage nose. Retractable fuselage belly pack for thirty-two 2.75-in. air-to-air rockets. Two Sidewinder infra-red missiles mounted externally on sides of fuselage.

DIMENSIONS.—
Span 35 ft. 8 in. (10.87 m.).
Length 54 ft. 2¾ in. (16.53 m.).
Height 15 ft. 9 in. (4.80 m.).
Width folded 22 ft. 6 in. (6.86 m.).

WEIGHT.—
Normal loaded weight approx. 27,000 lb. (12,250 kg.).

PERFORMANCE.—
Max. speed over 1,000 m.p.h. (1,600 km.h.).

THE CHANCE VOUGHT CRUSADER III.

U.S. Navy designation: F8U-3.

Although similar in many respects to the earlier versions of the F8U Crusader, the all-weather F8U-3 is of completely re-engineered design and is slightly larger all round.

The two-position variable-incidence wing is fitted with a boundary layer control system of the "flap-blowing" type, to maintain the Crusader's deck-landing qualities despite the greatly improved performance of the F8U-3, which is designed to fly at speeds above Mach 2.

More obvious external changes are the introduction of a swept-forward engine air intake of modified Ferri supersonic type, the longer pointed nose and better-streamlined cockpit canopy. Two movable ventral fins have been added towards the tail. These extend horizontally in low-speed flight and to avoid damage during take-off and landing, but are turned downward at an acute angle during high-speed flight to provide increased stability.

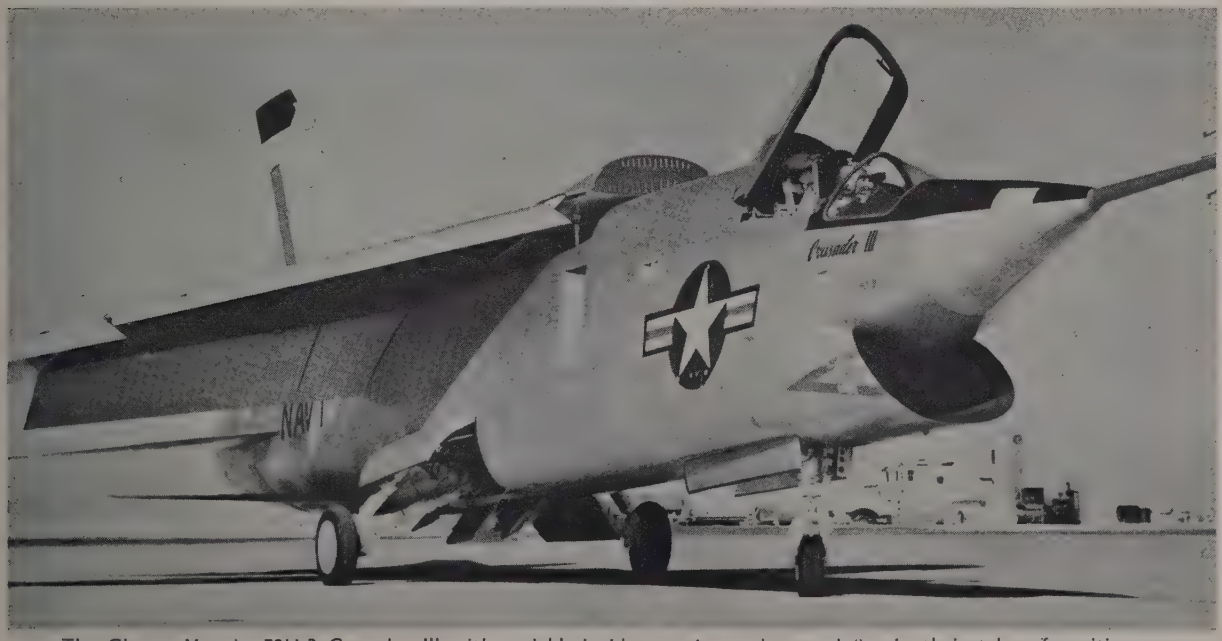
Power plant of the F8U-3 is a Pratt & Whitney J75, with afterburner, giving nearly 26,000 lb. (11,795 kg.) s.t. Initially, the F8U-3's armament comprises Sparrow III or Sidewinder missiles, or a combination of both; but it is designed to be capable of carrying a wide range of other weapons, electronic countermeasures equipment, photo-reconnaissance cameras or external fuel tanks.

The F8U-3 is claimed to have the most versatile electronic equipment ever fitted to a U.S. Navy fighter, including a missile fire-control system and an advanced "push-button" automatic flight control system that leaves the pilot free to concentrate on navigation and tactics. To climb to altitude after take-off, he simply pushes a "Mach hold" button and ascends at any desired rate and angle. To cruise, he engages an "Altitude hold" button. Another button ensures that the aircraft holds its heading automatically, and the heading can be changed by dialing a "Heading select indicator."

An "anticipatory G limiter" prevents manoeuvres that would place too great a load on the airframe, and a "roll rate limiter" ensures that the F8U-3 cannot perform in such a way that the pilot might lose control. Other safety features prevent over-travel of control mechanisms, sense troubles or malfunctions in certain circuits, and provide corrective action. All electronic equipment is packaged for easy servicing and replacement.

The prototype F8U-3 flew on June 2, 1958, and the type is scheduled to enter service with the U.S. Navy in 1960.

DIMENSIONS.—
Span 39 ft. 11.4 in. (12.17 m.).
Length 58 ft. 8.8 in. (17.89 m.).
Height 16 ft. 4½ in. (5.08 m.).



The Chance Vought F8U-3 Crusader III with variable-incidence wing and ventral fins in their take-off positions.

CLARK

CLARK AIRCRAFT, INC.

HEAD OFFICE AND WORKS: P.O. Box 903, MARSHALL, TEXAS.

This company is developing a new all-metal agricultural biplane known as the Clark 1000, the prototype of which flew for the first time on March 19, 1956. The first production model flew on May 3, 1957, and full details of this are given hereafter.

THE CLARK 1000.

TYPE.—Single-seat Agricultural biplane.

WINGS.—Single-bay equal-span staggered biplane. Clark wing section. Constant chord of 5 ft. 2 in. (1.57 m.). Dihedral (upper) ½°, (lower) 1½°. Incidence (upper) 4°, (lower) 3°. All-metal stressed-skin structure. All-metal stressed skin ailerons. No flaps. One "N" type streamline steel-tube interplane strut assembly on each side. Total area of ailerons 29.2 sq. ft. (2.71 m.²). Gross wing area 305.5 sq. ft. (28.38 m.²).

FUSELAGE.—All-metal semi-monocoque structure. Entire inside surfaces corrosion-protected.

TAIL UNIT.—Monoplane type. All-metal stressed skin structure. Areas: fin 5.6 sq. ft. (0.52 m.²), rudder 11.1 sq. ft. (1.03 m.²), tailplane 28 sq. ft. (2.60 m.²), elevators 14 sq. ft. (1.30 m.²). Tailplane span 12 ft. (3.66 m.).

LANDING GEAR.—Divided type. Neoprene disc shock-absorbers. Hayes wheels .850 × 10 tyres. Goodrich brakes. 10 in. (0.25 m.) tail-wheel. Wheel track 7 ft. 6 in. (2.29 m.). Wheelbase 17 ft. 6 in. (5.33 m.).

POWER PLANT.—One 220 h.p. Continental R-670, or 225 h.p. Lycoming R-680 or 245 h.p. Jacobs R-755 radial air-cooled engine. Two blade adjustable-pitch metal airscrew. Fuel tank in centre-section, capacity 46 U.S. gallons (174 litres). Oil capacity 4.4 U.S. gallons (16.6 litres).

ACCOMMODATION.—One open cockpit, with padded instrument panel. Essential instruments mounted in line of vision.

EQUIPMENT.—Fiberglas hopper in fuselage forward of cockpit, capacity 160 U.S. gallons (605 litres).

DIMENSIONS.—
Span 30 ft. 5 in. (9.30 m.).
Length 24 ft. 11 in. (7.58 m.).
Height 10 ft. 2 in. (3.10 m.).

WEIGHTS.—
Weight empty 2,120 lb. (962 kg.).
Structural gross weight 3,520 lb. (1,597 kg.).
Wing loading 11.5 lb./sq. ft. (56.15 kg./m.²).

PERFORMANCE.—
Max. speed 100 m.p.h. (161 km.h.).
Cruising speed 85 m.p.h. (137 km.h.).

COLONIAL

COLONIAL AIRCRAFT CORPORATION.

HEAD OFFICE AND WORKS: SANFORD, MAINE.

President: David B. Thurston.

The Colonial Aircraft Corpn. was formed in 1946 by Mr. D. B. Thurston and a group of four other designers and builders to build the Skimmer single-engined pusher amphibian flying-boat. The Skimmer C-1 received C.A.A. Type Certificate 1A13 on September 19, 1955 and the C-2 Type Certificate 1A13 (amended) on December 18, 1957. Both the C-1 and C-2 are in production.

THE COLONIAL MODEL C-1 SKIMMER.

TYPE.—Single-engined 2/3-seat Amphibian.

WINGS.—Cantilever shoulder-wing monoplane with tapered wing sections attached directly to sides of hull. Structure consists of duralumin leading and trailing-edge torque boxes separated by a single duralumin main spar or beam. All-metal ailerons. Hydraulically-operated slotted flaps over 80 per cent. of span. Gross wing area 150.6 sq. ft. (14 m.²).

HULL.—Single-step all-metal structure, with five watertight compartments.

TAIL UNIT.—Cantilever monoplane type. All-metal construction. Controllable elevator trim-tabs. Span of tail 10 ft. (3.05 m.), vertical tail area 22.7 sq. ft. (2.1 m.²), horizontal tail area 26.39 sq. ft. (2.45 m.²).

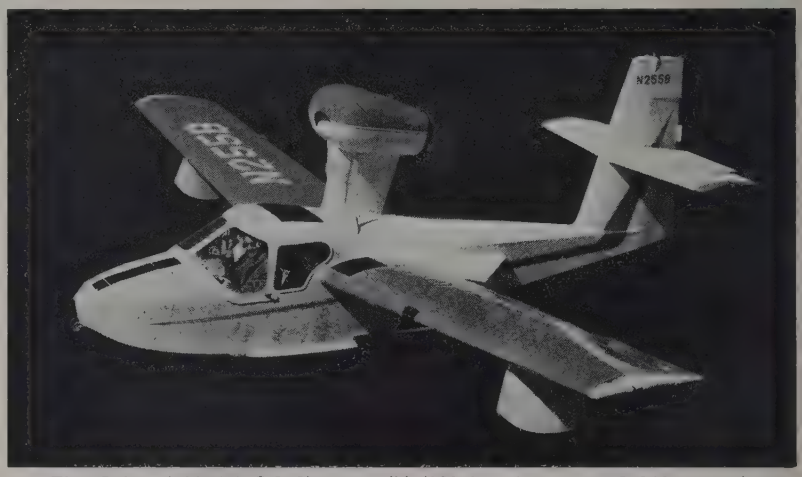
LANDING GEAR.—Retractable tricycle type. Knee-action oleo struts on main gear, which retracts into wings. Long-stroke nose-wheel oleo. Nose-wheel protrudes when retracted to serve as bumper. Hydraulic retraction using a pressurised accumulator-reservoir as a source of energy. Goodrich wheels, tyres and hydraulic brakes. Nose-wheel is free to swivel 30° either way.

POWER PLANT.—One 150 h.p. Lycoming O-320 four-cylinder horizontally-opposed air-cooled engine mounted on pylon above hull and driving a Hartzell constant-speed airscrew 6 ft. 2 in. (1.8 m.) diameter. Normal fuel capacity 30 U.S. gallons (113 litres). Overload fuel capacity 39 U.S. gallons (148 litres).

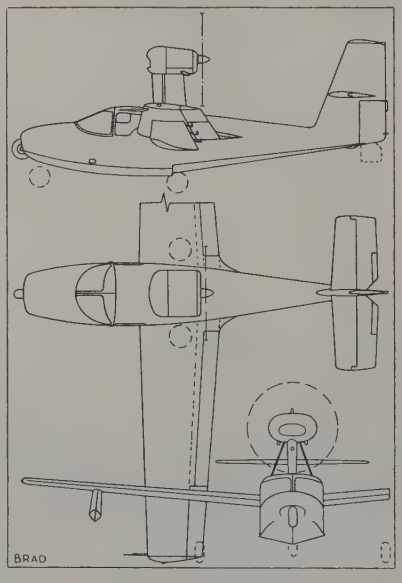
ACCOMMODATION.—Enclosed cabin normally seating two side-by-side, but third person (or two children) may be seated behind. Single wheel control standard but dual controls available. Blind-flying instruments, two-way VHF radio and landing lights optional. Baggage capacity of over 24 cub. ft. (0.68 m.³) available in passenger compartment.

EQUIPMENT.—Towbar, paddle and anchor.

DIMENSIONS.—
Span 34 ft. (10.37 m.).
Length 23 ft. 6 in. (7.16 m.).
Height overall 8 ft. 10 in. (2.68 m.).



The Colonial Model C-2 Skimmer IV (180 h.p. Lycoming O-360 engine).



The Colonial Skimmer.

WEIGHTS AND LOADINGS.—
Weight empty 1,425 lb. (646 kg.).
Disposable load 725 lb. (329 kg.).
Weight loaded 2,150 lb. (975 kg.).
Wing loading 14.27 lb./sq. ft. (69.67 kg./m.²).
Power loading 14.33 lb./h.p. (6.50 kg./h.p.).

PERFORMANCE.—
Max. speed at 5,000 ft. (1,525 m.) 125 m.p.h. (201 km.h.).
Cruising speed 123 m.p.h. (198 km.h.).
Stalling speed 50 m.p.h. (80 km.h.).
Initial rate of climb 700 ft./min. (213 m./min.).
Take-off distance on water in still air 1,500 ft. (457 m.).
Take-off distance on land in still air 550 ft. (168 m.).
Cruising range 500 miles (805 km.).

THE COLONIAL MODEL C-2 SKIMMER IV.

The C-2 is identical to the C-1 except that it is a four-seater and is powered by a 180 h.p. Lycoming O-360 engine.

DIMENSIONS.—
See Model C-1.

WEIGHTS.—
Weight empty 1,520 lb. (690 kg.).
Disposable load 830 lb. (377 kg.).
Weight loaded 2,350 lb. (1,067 kg.).

PERFORMANCE.—
Cruising speed 135 m.p.h. (216 km.h.).
Stalling speed 52 m.p.h. (83 km.h.).
Initial rate of climb 800 ft./min. (244 m./min.).
Cruising range 500 miles (805 km.).

CONVAIR

CONVAIR DIVISION OF GENERAL DYNAMICS CORPORATION.

HEAD OFFICE: SAN DIEGO 12, CAL.

MANUFACTURING DIVISIONS: SAN DIEGO (2) AND POMONA, CAL. AND FORT WORTH, TEX.

President: J. V. Naish.

Director of Planning and Assistant to President: E. P. Wohl.

Vice-President and Assistant to President: T. G. Lanphier.

Vice-President: R. H. Biron.

Vice-President—Engineering: R. C. Sebold.

Vice-President and General Counsel: R. B. Watts.

Vice-President and Manager, Fort Worth Division: A. C. Esenwein.

Vice-President and Manager, San Diego Division: Bernard F. Coggan.

Vice-President and Manager, Pomona Division: Charles F. Horne.

Manager, Astronautics Division (San Diego): J. R. Dempsey.

Manager, Daingerfield Division: J. E. Arnold.

Controller: R. R. Brewton.

Secretary: Edmund Burke.

Treasurer: G. T. Bovee.

Consolidated Vultee Aircraft Corporation resulted from the merger on March 17, 1943, of the properties of the Consolidated Aircraft Corporation and Vultee Aircraft, Inc. The original Consolidated Aircraft Corporation had been incorporated on May 29, 1923.

Before the merger with Vultee in 1943, Consolidated acquired the Thomas-Morse Aircraft Corporation of Ithaca, N.Y., and the Hall Aluminium Aircraft Corporation.

On March 1, 1954, the directors of Consolidated Vultee and the General Dynamics Corporation, which had become



The Convair F-106A Delta Dart (Pratt & Whitney J75 turbojet engine and afterburner).

the largest shareholder in Convair during 1953, voted to merge the two Corporations and on April 30, 1954, Consolidated Vultee became the Convair Division of General Dynamics Corporation.

The present activities of the manufacturing divisions may be summarised as follows :—San Diego Division : production of the Convair 880 jet transport ; the F-102A delta-wing supersonic interceptor fighter and TF-102A trainer ; the F-106A and F-106B supersonic all-weather interceptors ; and research and development in pilotless aircraft, guided missiles, new types of pilot ejection seat for supersonic aircraft and other restricted projects : Pomona Division :—research, development and production of Terrier and Tartar guided missiles for the U.S. Navy Bureau of Ordnance ; Fort Worth Division :—production of the B-58 and forward fuselage assemblies for the F-106B, and research and development work on restricted projects : Astronautics Division (at San Diego) ; design, development, manufacturing and testing of the Atlas intercontinental ballistic missile (ICBM) and preliminary design work concerned with space travel. The Division's own large new plant was fully occupied during 1958.

In addition to these production activities, the Fort Worth Division has major contracts to modernize, inspect and repair F-102 interceptors and to convert C-54 transport aircraft for air rescue duties.

Production of the Convair 440 Metropolitan twin-engined airliner was phased out in the Spring of 1958 as work on the new Convair 880 increased. One set of Model 440 major tooling has been sent to Canadair Ltd. of Montreal for use in building the Canadair 540 turboprop transport, of which a full description appears under the Canadair entry. Altogether, 1,075 commercial and military aircraft of the Convair 240/340/440 series were built between 1947 and 1958.

Convair retains detailed tooling for high-usage spares, including all control surfaces and leading-edges for the Convair-Liner and will manufacture these components for Canadair as well as for Convair 240, 340 and 440 operators. All engineering, maintenance, spares and service facilities for all present and future operators of Convair 240, 340 and 440 twin-engined aircraft will continue to be handled by Convair-San Diego.

The Daingerfield Division at Daingerfield, Texas, operates for the U.S. Navy Bureau of Ordnance a highly-important but little publicised Ordnance Aerophysics Laboratory which includes a ramjet burner test centre for the development of guided missiles.

THE CONVAIR DELTA DART.

U.S.A.F. designation: F-106.

The F-106 is a developed version of the F-102. It was formerly designated F-102B ; but because of structural changes and use of the more powerful Pratt & Whitney J75 turbojet with afterburner, it has been redesignated.

Externally evident changes compared with the F-102A are a revised square-tip fin shape and repositioning of the engine air intakes further aft on the fuselage.

Two versions have been ordered into large-scale production for the U.S.A.F., as follows :—

F-106A. Initial production version.



The Convair F-106B, the two-seat version of the single-seat F-106A All-weather Interceptor.



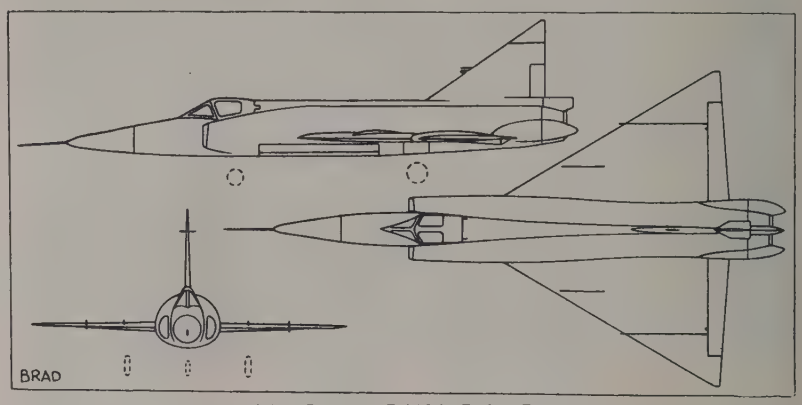
The Convair F-102A Delta Dagger All-weather Interceptor (Pratt & Whitney J57 turbojet engine with afterburner). (*Warren Bodie*).

Prototype first flew at Edwards Air Force Base, Calif., on December 26, 1956.

F-106B. Tandem two-seat version, ordered into parallel production with F-106A in April, 1957. Prototype flew for first time in April, 1958.

Both versions are supersonic all-weather interceptors and it has been stated that the F-106A carries the most sophisticated armament and fire control system yet developed for an interceptor aircraft. The standard designed armament is reported to be two Douglas MB-1 Genie air-to-air missiles with nuclear warhead, plus a number of Hughes GAR-1D and GAR-2A Falcon missiles.

DIMENSIONS (F-106A).—
Span 38 ft. 3½ in. (11.67 m.).
Length 70 ft. 8¾ in. (21.56 m.).
Height 20 ft. 3½ in. (6.18 m.).



The Convair F-102A Delta Dagger.

THE CONVAIR DELTA DAGGER.
U.S.A.F. designation: F-102.

The F-102 is a supersonic single-seat all-weather delta-wing interceptor which is in production at San Diego. It is fitted with an automatic electronic control system which needs only to be monitored by the pilot and its main armament of six Hughes GAR-1D Falcon guided missiles is automatically fired.

Design of the F-102 began in 1951, after Convair had won a U.S.A.F. competition for an interceptor to carry the Falcon and its associated fire control system. As far as possible, it was a direct 1.22 : 1 scale-up of the earlier Convair XF-92A research aircraft, which was the first true delta-wing aeroplane to fly; but in detail the F-102 was largely re-designed, making extensive use of pressings made from very large forgings to speed production.

The following versions have appeared:—

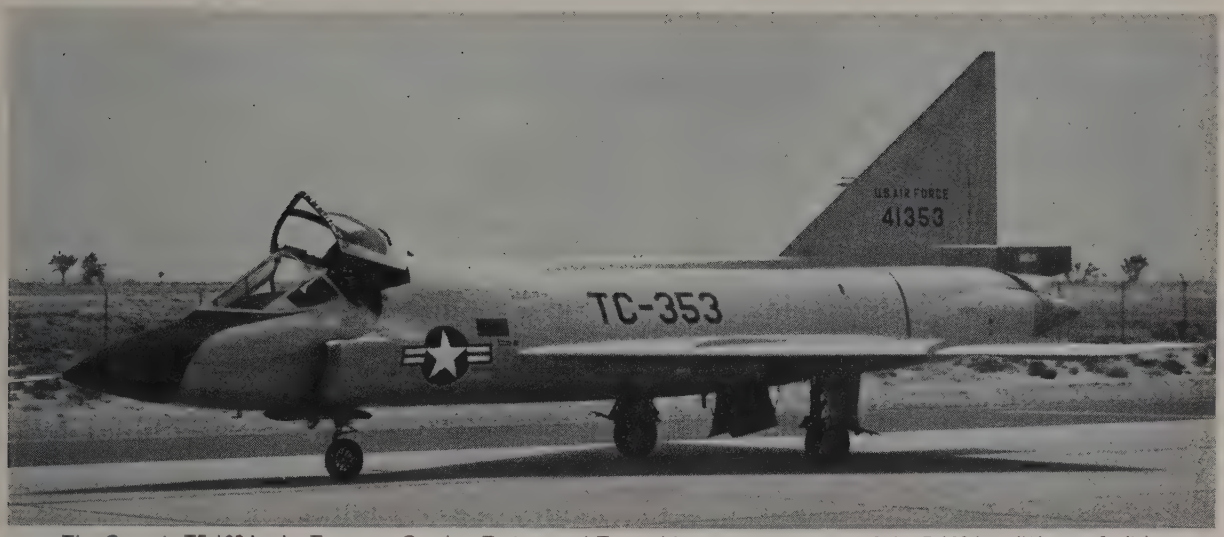
YF-102. Two prototypes, powered by Pratt & Whitney J57-P-11 turbojet with afterburner. First YF-102 flew on October 24, 1953; second on January 11, 1954. Initial production aircraft of this type were subsequently modified to virtual F-102A standard.

YF-102A. Developed version incorporating major design changes found essential for flight to transonic and supersonic speeds. Longer fuselage incorporating the NACA "area-rule" that gives the fuselage a pinched-in waisted effect just forward of streamlined fairings at the aft end of the fuselage. Delta wing given cambered leading-edges and swept-up wing-tips. Canopy re-designed to give the pilot greater visibility. More powerful J57 turbojet. Design generally improved for easier production and servicing. Re-design took 117 working days and first YF-102A flew on December 20, 1954. It exceeded the speed of sound in level flight on the following day.

F-102A. Production version, described below. One F-102A was converted for evaluation in tactical rôle in



The Convair F-102A Delta Dagger (Pratt & Whitney J57 turbojet engine with afterburner).



The Convair TF-102A, the Two-seat Combat Trainer and Tactical Interceptor version of the F-102A. (*Warren Bodie*).

the Spring of 1957. Many F-102A's are now being modernised, including improvements to their fire-control system.

TF-102A. Two-seat combat proficiency trainer and tactical interceptor version of F-102A. Length reduced to 63 ft. 4½ in. (19.32 m.).

F-102B. Developed and extensively redesigned all-weather interceptor version. Redesignated F-106A and described separately.

The last F-102 was completed in April, 1958, after about 1,000 of the two production versions—F-102A and TF-102A—had been built.

TYPE.—Single-seat All-weather interceptor.

WINGS.—Cantilever mid-wing monoplane of delta shape. Leading-edge sweepback 60° 6′ 13″. Root chord 29 ft. 9¼ in. (9.07 m.). All-metal structure with five forged one-piece spars in each wing. Machined aluminium alloy (Alcoa 2024-T86) skins. Conical camber leading edge. Integral fuel tank bays fore and aft of landing gear bay. Elevons of bonded honeycomb construction, each divided into inner and outer sections operated by irreversible hydraulic jacks. Wing area 661.5 sq. ft. (61.45 m.²).

FUSELAGE.—All-metal semi-monocoque structure, with titanium alloy frames in vicinity of power plant.

TAIL UNIT.—Vertical fin and rudder only, of all-metal construction. Height of fin increased from 104 in. (264 cm.) to 137 in. (348 cm.) on later production aircraft by reducing leading-edge sweepback to 52°. Areas: fin 83.75 sq. ft. (7.78 m.²), rudder 11.25 sq. ft. (1.04 m.²). Braking parachute housed inside forward-opening speed brakes aft of fin.

LANDING GEAR.—Retractable tricycle type. Hydraulic actuation. Menasco shock-absorber units. Wheel track 14 ft. 2¼ in. (4.32 m.). Wheelbase 22 ft. 4½ in. (6.86 m.).

POWER PLANT.—One Pratt & Whitney J57-P-35 turbojet engine, rated at 10,900 lb. (4,945 kg.) dry and 17,000 lb. (7,710 kg.) with afterburner in operation. Fuel in two integral tanks in each wing and in fuselage aft of missile bay. A jettisonable external fuel tank can be carried under each wing.

ACCOMMODATION.—Pilot seated on Weber ejection seat in air-conditioned and pressurised cockpit. Normal pressurisation 7.2 lb./sq. in. (0.506 kg./cm.²) requires use of MC-1 partial-pressure suit above 50,000 ft. (15,240 m.). Vee-shaped windscreen with de-misting. Rearward-hinged stretched plastic canopy.

ARMAMENT.—Six Hughes GAR-1D Falcon air-to-air guided missiles mounted on short rails which extend from three missile bays when rapid-acting doors are opened. Secondary armament of 2.75 in. folding fin rockets in firing channels built into missile bay doors. Primary armament fired automatically by Hughes MG-10 fire control system mounted in fuselage nose. This can also take over complete task of controlling aircraft and effecting interception, with aid of new "Digitair" computer, leaving pilot free to monitor mission.

DIMENSIONS.—
Span 38 ft. 1½ in. (11.62 m.).
Length 68 ft 3 in. (20.81 m.).
Height 20 ft. 7½ in. (6.27 m.).

WEIGHTS AND PERFORMANCE.—
No details available.

THE CONVAIR WS-125A.

Convair are developing a long-range nuclear-powered bomber for the U.S.A.F. under the Weapons System designation WS-125A. No details are available.

THE CONVAIR HUSTLER.

U.S.A.F. designation: B-58.

The B-58 is a multi-engined supersonic delta-wing bomber which was developed under the U.S.A.F.'s "weapon system concept." This makes Convair responsible not only for the airframe but for finding, developing, buying and installing all items of equipment (except engines) previously furnished by the government. As a result large contracts have been placed with seven "systems vendors" and 21 major sub-contractors. In addition, there are an estimated 1,500 other firms supplying items used in the B-58 programme.

Before it flew, many of the B-58's subsystems were flight tested in a fleet of two B-36's, three C-131B's, an F-89, F-86 and B-47.

The first prototype flew for the first time on November 11, 1956, and this aircraft had completed 51½ hours' flying in 17 flights by February, 1957. The second prototype, first flown in February, 1957, has been fitted with the detachable streamlined under-fuselage pod which is part of the weapons system and can house alternative military loads. These are reported to include air-to-ground nuclear



The first prototype Convair B-58 Hustler (four General Electric J79 turbojet engines) with its under-fuselage pod.



The first prototype Convair B-58 Hustler Delta-wing Bomber (four General Electric J79 turbojet engines).

weapons, both guided and unguided; a Sylvania electronic countermeasures system to shield a bomber force from radar interception; and interception equipment.

A Vulcan 20 mm. multi-barrel cannon is carried in a flexible mounting in the fuselage tail-cone for defensive purposes.

A third B-58 airframe was flown under the bomb-bay of a Convair B-36 to Wright-Patterson Air Force Base for structural testing in the Spring of 1957.

The B-58 is powered by four General Electric J79 turbojets in underwing pods, and carries a crew of three in separate tandem cockpits in the fuselage nose. Its thin delta wings have conical-camber leading-edges. Control surfaces include wide-chord elevons from the wing-root fairings to the outboard engine pods, with spoilers immediately forward of the elevons and small trim tabs inboard of them. Each main landing gear unit has an eight-wheel bogie and the nose-gear is a twin-wheel unit. A large ribbon braking parachute is housed under the tail end of the fuselage.

The Hamilton Standard automatic air conditioning and pressurisation system is claimed to be the most extensive fitted in any aeroplane. It provides cooling for the cockpits, wheel wells and electronic installations, controls heating, pressurises the cabin, de-humidifies the cabin air and provides demisting and rain removal air for the windscreen.

An initial U.S.A.F. contract for a service test batch of 13 B-58's was followed in the Spring of 1957 by an order for a production batch of 18 of these aircraft. A further series of 47 is reported to be included in the 1959 procurement programme. All are being built at Convair's Fort Worth plant.

It was reported in September, 1957 that when General Power, Chief of the U.S.A.F. Strategic Air Command, flew in a B-58, it attained Mach 2.09 (equivalent to 1,380 m.p.h. = 2,220 km.h.) at 50,000 ft. (15,250 m.). Since then, a B-58 has been flown continuously at supersonic speed for over 1½ hours.

DIMENSIONS.—
Span 57 ft. (17.37 m.).
Length 97 ft. (29.57 m.).
Height 31 ft. (9.45 m.).

WEIGHT.—
Weight loaded approx. 160,000 lb. (72,570 kg.).

PERFORMANCE.—
Normal max. speed Mach 1.7.

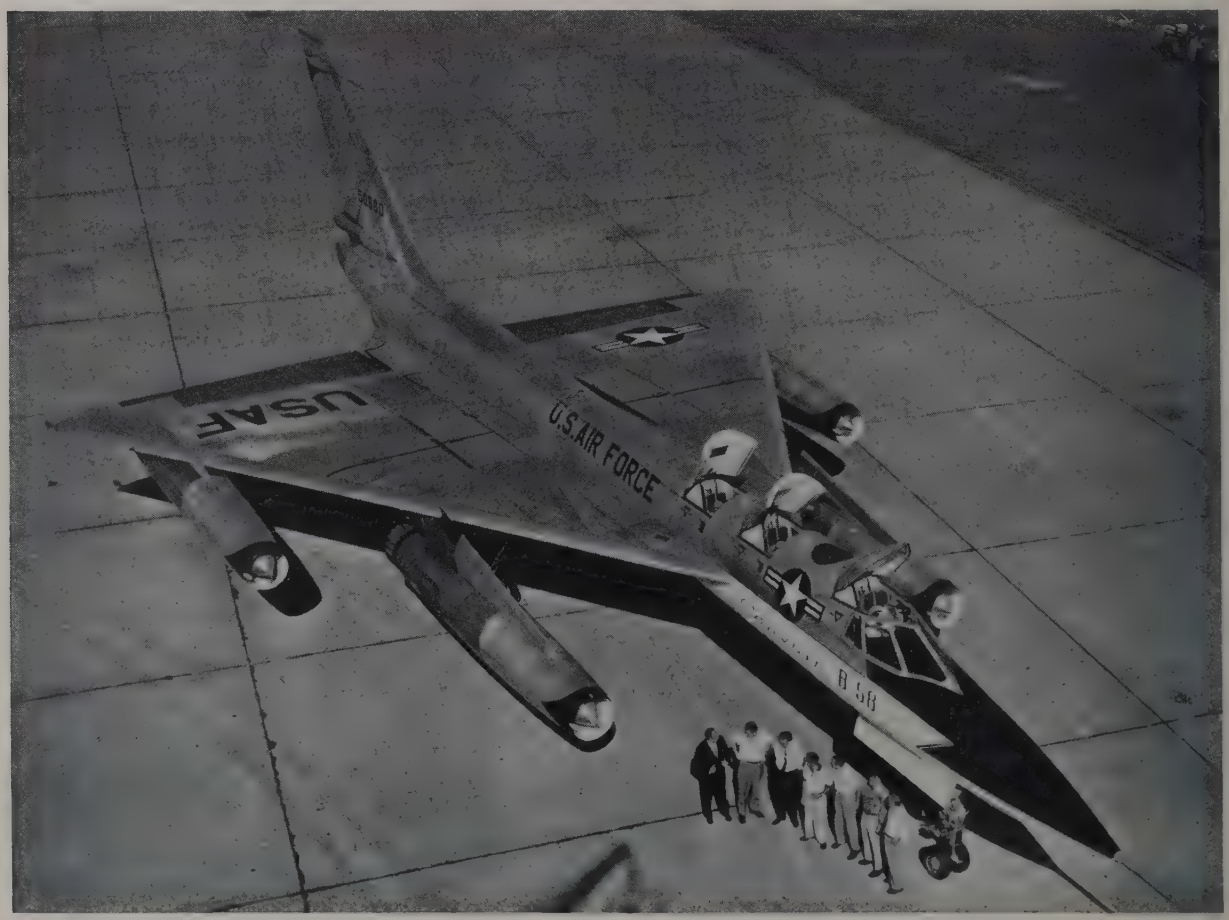
THE CONVAIR 880.

First announced in April, 1956, the Convair 880 is a four-jet transport aircraft for medium range routes. Production 880's are offered for delivery in 1959.

First orders for the 880 were from T.W.A. (30) and Delta Air Lines (10), followed by orders for four from Transcontinental S.A. (Argentina), four from REAL (Brazil) and five from Swissair.

TYPE.—Medium-range jet-powered Airliner.

WINGS.—Low-wing cantilever monoplane. Chord at root 35 ft. 8½ in. (10.88 m.).



Another view of the first prototype Convair B-58 Hustler Delta-wing Bomber.

Aspect ratio 7.0. Dihedral 7°. Sweepback 35° at 30% chord. All-metal structure with three main spars and additional auxiliary spar at root. Leading-edge double-skinned to provide duct for hot air for de-icing. Manually-operated ailerons are linked with hydraulically-operated spoilers through "mixing box." All-metal double-slotted flaps in three sections each side. Wing area 2,000 sq. ft. (185.8 m.²).

Fuselage.—Circular-section all-metal structure.

Tail Unit.—Cantilever monoplane type with 35° sweepback on all leading-edges. Moderate dihedral on tailplane. Hydraulically-operated variable-incidence tailplane. Rudder and elevators controlled manually through servo tabs. Area of horizontal surfaces 395 sq. ft. (36.7 m.²). Area of vertical surfaces 295 sq. ft. (27.4 m.²).

Landing Gear.—Ten-wheel gear manufactured by Cleveland Pneumatic Tool Company. Two main units each have single shock-absorber strut and two articulated tandem-wheel units. Twin-wheel nose unit. Main wheels have 7.50 × 14 tyres (80 lb./sq. in. = 5.62 kg./cm.²), nose wheels 12.50 × 16 tyres (115 lb./sq. in. = 8.08 kg./cm.²)—pressures in brackets. All gears hydraulically retractable, but main gears may be lowered independently by free fall into down-and-lock position to serve as drag brakes for speed reduction. Air-cooled disc-type brakes on both main and nose units. Anti-skid units in wheel axles to permit removal of wheels without disturbing anti-skid units. 880 will be able to manoeuvre under its own power in an 85-foot circle by means of power-steering nose wheel unit, which may be turned through an arc of 140 degrees. Wheel track (C/L of shock struts) 18 ft. 10½ in. (5.75 m.). Wheelbase (C/L of shock struts) 52 ft. 11 in. (16.13 m.).

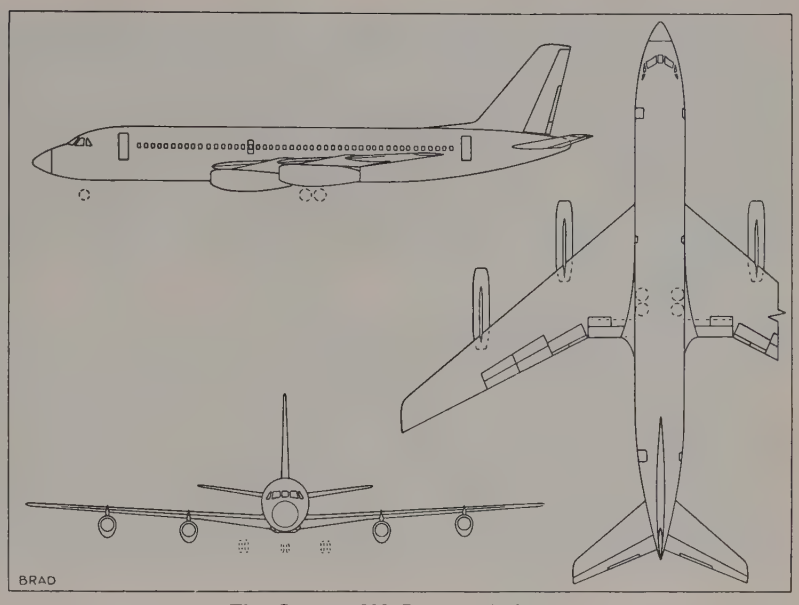
Power Plant.—Four General Electric CJ-805-3 turbojet engines of 11,200 lb. (5,080 kg.) s.t. each, on forward-inclined cantilever struts under wing leading-edges. Total fuel capacity 10,800 U.S. gallons (40,882 litres).

Accommodation.—Crew of 5 and seats for 88 first-class or up to 109 tourist class passengers. Cabin is 89 ft. 3 in. long, 10 ft. 8 in. wide (maximum) and 7 ft. 1 in. high (maximum) (27.2 × 3.25 × 2.15 m.). Cargo compartments (2) with total capacity of 863 cub. ft. (24.4 m.³). Hamilton Standard air-conditioning system.

Dimensions.—
Span 120 ft. (36.58 m.).
Length 129 ft. 4 in. (39.42 m.).
Height 36 ft. 0 in. (10.97 m.).

Weights (Estimated).—
Weight empty 82,100 lb. (37,240 kg.).
Max. weight loaded 178,500 lb. (80,965 kg.).
Max. landing weight 132,800 lb. (60,240 kg.).
Max. zero-fuel weight 117,000 lb. (53,070 kg.).
Wing loading 89.25 lb./sq. ft. (435.8 kg./m.²).

Performance (Estimated).—
Max. cruising speed at 25,000 ft. (7,620 m.). 615 m.p.h. (990 km.h.).
Recommended continuous cruising speed (90% max. cruise power) at 25,000 ft. (7,620 m.) and 135,000 lb. (61,235 kg.) 583 m.p.h. (938 km.h.).
Balanced field length (I.S.A. at max take-off weight) 7,000 ft. (2,135 m.).
Landing distance from 50 ft. (15.25 m.) 3,500 ft. (1,065 m.).
Range with max. fuel in still air with 22,680 lb. (10,287 kg.) payload at 493 m.p.h. (793 km.h.) mean at 35,000 ft. (10,670 m.) mean, no allowances 4,350 miles (7,000 km.).
Range with max. payload at long-range cruising speed at 35,000 ft. (10,670 m.) 3,000 miles (4,800 km.).



The Convair 880 Four-jet Airliner.

THE CONVAIR MODEL 600.

Announced on July 30, 1958, the Convair 600 has been developed from the Model 880 to meet the specific requirements of American Airlines, who have ordered 25, with an option on 25 more.

Its fuselage is some 10 ft. (3.05 m.) longer that that of the Convair 880 and it has four of the new General Electric CJ-805-21 ducted-fan type turbojet engines, which will increase its maximum cruising speed to just under Mach .91 at height. The wing is equipped with new leading-edge devices and a newly-designed trailing-edge to reduce landing speeds. In addition two tapered fairings have been added on the trailing-edge of each wing in conformity with the area rule. Accommodation will be for 90-120 passengers, depending on route requirements, with a cargo capacity of 928 cub. ft. (26.28 m.³).

First flight of the Convair 600 is scheduled for August, 1960, with production deliveries beginning in June, 1961.

Dimensions.—
Span 120 ft. (36.58 m.).
Length 139 ft. 5 in. (42.50 m.).
Height 37 ft. 6 in. (11.45 m.).
Wing area 2,250 sq. ft. (209 m.²).

Weights.—
Max. take-off weight 238,200 lb. (108,050 kg.).
Max. landing weight 180,000 lb. (81,650 kg.).

Performance (estimated).—
Max. cruising speed at 35,000 ft. (10,670 m.) 635 m.p.h. (1,022 km.h.).

THE CONVAIR 440 METROPOLITAN.

The Model 440 is a development of the 340 with modifications to increase speed (by about 5 m.p.h. = 8 km.h.) and to reduce the noise level in the cabin. To improve performance the engine cowling, baffles and the "aspirated cooling" exhaust have been re-designed and aileron and flap seals have been fitted.

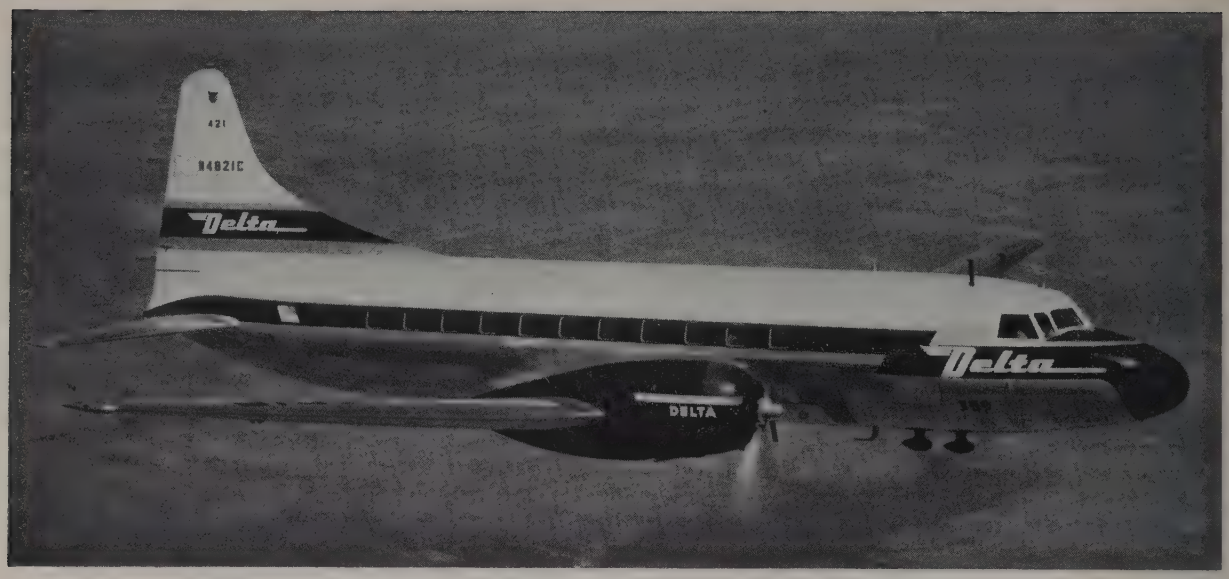
The cabin is provided with improved sound-proofing and, in addition, special inner window assemblies have been installed for the first eight rows of seats as an additional means to suppress engine, propeller and exhaust noise.

The Model 440 is in service with either Pratt & Whitney R-2800-CB-16 or CB-17 engines and in 44 and 52 seat versions.

Special kits are available for converting Model 340's up to 440 standard.



An artist's impression of the Convair Model 600 (four General Electric CJ-805 ducted-fan engines).



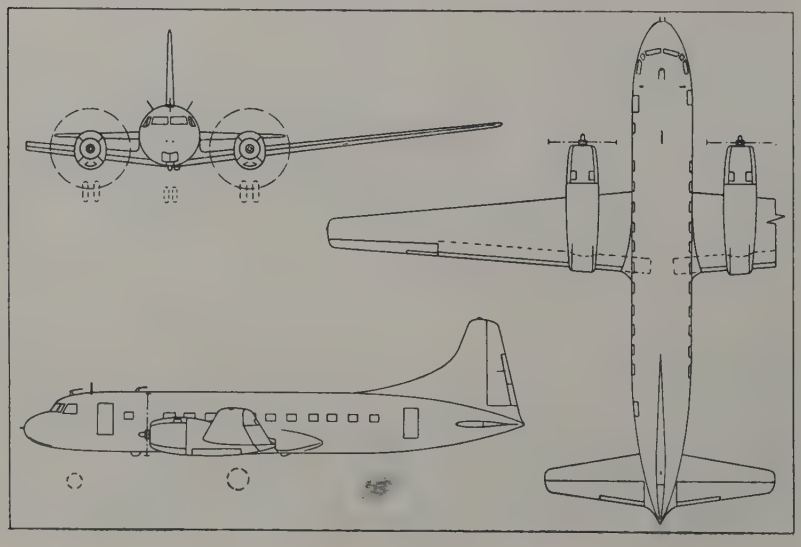
The Convair 440 Metropolitan Airliner (two 2,400 h.p. Pratt & Whitney R-2800 engines).

One 440 has been re-engined with two Napier Eland turboprop engines by Pacific Aeromotive Engineering Corpn. for D. Napier and Son, who are offering Eland conversion kits to operators of Convair Model 340 and 440 aircraft.

The prototype Model 440 flew on October 6, 1955, followed by the first production aircraft on December 15, 1955.

When production was phased out in the Spring of 1958, a total of 162 Model 440's had been built for REAL (Brazil) (15), Continental Air Lines (3), SAS (20), Aero O/Y (Finland) (3), Sabena (12), Swissair (12), National Airlines (6), Braniff International Airways (6), Delta Air Lines (8), Eastern Air Lines (20), Alitalia (2), Iberia (5), Jugoslovenski Aerotransport (2), Kar-Air (Finland) (2), Ansett Airways (6), Cruzeiro do Sul (Brazil) (4), Deutsche Lufthansa (5), Air Carrier Corp. (Japan) (2), Garuda Indonesian Airways (3), Avensa (Venezuela) (2), U.S. Air Force (6), Royal Australian Air Force (2), Italian Air Force (1) and private customers (15).

A major proportion of the jigs and tools for the 440 have now been transferred to Canadair, Ltd., Montreal, for the production of the Canadair 540 (CL-66), a Canadian development of the 440 powered by two Napier Eland turboprop engines (see Canadair).



The Convair 440 Metropolitan Airliner.

TYPE.—Twin-engined medium-range Airliner.

WINGS.—Low-wing cantilever monoplane. All-metal structure with stressed-skin covering. Thermal anti-icing. NACA 63.4-120. Wing section. Aspect ratio 12. Chord (mean) 9 ft. 6.3 in. (2.90 m.). Dihedral 4° 50′ on centre wings; 6° 30′ on outer wings. Incidence 4°. All-metal aluminium alloy ailerons and Fowler flaps. Area of ailerons 43.82 sq. ft. (4.07 m.²). Wing area 963.82 sq. ft. (89.54 m.²).

FUSELAGE.—Circular-section aluminium alloy structure with stressed skin covering.

TAIL UNIT.—Cantilever monoplane type. Aluminium alloy structure. Rudder and elevators fitted with trim and servo-control tabs. Thermal anti-icing for leading-edges of fin and tailplane.

LANDING GEAR.—Retractable tricycle type. All three units fitted with twin wheels. Steerable nose-wheel. Oleo-pneumatic shock-absorber struts. Wheel track 25 ft. (7.62 m.).

POWER PLANT.—Two Pratt & Whitney R-2800-CB-16 eighteen-cylinder radial air-cooled engines, each rated at 1,800 h.p. at 8,500 ft. (2,590 m.) in low blower and 1,700 h.p. at 14,500 ft. (4,240 m.) in high blower, and with 2,400 h.p. available for take-off, with water injection, or two Pratt & Whitney R-2800-CB-17 engines, each rated at 1,900 h.p. at 7,000 ft. (2,135 m.) in low blower and 1,750 h.p. at 13,500 ft. (4,115 m.) in high blower, and with 2,500 h.p. available for take-off, with water injection. Three-blade Hamilton Standard Hydromatic automatic fully-feathering and reversing airscrews, diameter 13 ft. 6 in. (4.11 m.). Integral fuel tanks outboard of engine nacelles, with maximum capacity of 1,730 U.S. gallons (6,548 litres). Oil capacity 60 U.S. gallons (227 litres).

ACCOMMODATION.—Crew of three/four. Cabin seats 44 or 52 passengers in pairs on each side of a central aisle. Integral self-contained stairway located forward of wings on port side. Cabin is pressurised, with radiant-wall heating and refrigeration to maintain a constant cabin temperature in the air and on the ground. Cargo compartments fore and aft of cabin and below cabin floor forward of wings.

DIMENSIONS.—
Span 105 ft. 4 in. (32.12 m.).
Length 79 ft. 2 in. (24.14 m.).
Height 28 ft. 2 in. (8.59 m.).

WEIGHTS AND LOADINGS (CB-16 engines).—
Weight empty 31,305 lb. (14,199 kg.).
Max. take-off weight 48,000 lb. (21,772 kg.).
Max. landing weight 47,650 lb. (21,614 kg.).
Max. wing loading 52.1 lb./sq. ft. (254.3 kg./m.²).
Max. power loading 10 lb./h.p. (4.54 kg./h.p.).

WEIGHTS AND LOADINGS (CB-17 engines).—
Weight empty 31,305 lb. (14,199 kg.).
Max. take-off weight 49,100 lb. (22,271 kg.).
Max. landing weight 47,650 lb. (21,614 kg.).
Max. wing loading 53.3 lb./sq. ft. (260.2 kg./m.²).
Max. power loading 9.82 lb./h.p. (4.45 kg./h.p.).

PERFORMANCE (CB-16 engines).—
Max. speed 309 m.p.h. (497 km.h.).
Average cruising speed (1,200 h.p. per engine) at 20,000 ft. (6,100 m.) and A.U.W. of 45,000 lb. (20,412 kg.) 289 m.p.h. (465 km.h.).
Stalling speed at 46,500 lb. (21,092 kg.) A.U.W. 85 m.p.h. (137 km.h.).
Range with 1,500 lb. (680 kg.) fuel reserve, 1,200 h.p. per engine, zero wind, 45,000 lb. (20,412 kg.) A.U.W., at 20,000 ft. (6,100 m.) 1,040 miles (1,674 km.).
Rate of climb at S/L. 1,192 ft./min. (363 m./min.).
Service ceiling 25,500 ft. (7,770 m.).
Max. CAR operating height with one engine inoperative at 45,000 lb. (20,412 kg.) A.U.W. 9,500 ft. (2,895 m.).
Required CAR runway length for T.O. at S/L. at max. T.O. weight 4,930 ft. (1,503 m.).
Required CAR runway length for landing at S/L. at 46,500 lb. (21,092 kg.) A.U.W. 3,980 ft. (1,213 m.).

PERFORMANCE (CB-17 engines).—
Max. speed 310 m.p.h. (499 km.h.).
Average cruising speed (1,200 h.p. per engine) at 20,000 ft. (6,100 m.) and A.U.W. of 45,000 lb. (20,412 kg.) 289 m.p.h. (465 km.h.).
Stalling speed at 46,500 lb. (21,092 kg.) weight 85 m.p.h. (137 km.h.).
Range with 1,500 lb. (680 kg.) fuel reserve, 1,200 h.p. per engine, zero wind, 45,000 lb. (20,412 kg.) A.U.W., at 20,000 ft. (6,100 m.) 1,300 miles (2,092 km.).
Rate of climb at S/L. 1,260 ft./min. (384 m./min.).
Service ceiling 24,900 ft. (7,590 m.).
Max. CAR operating height with one engine inoperative at 45,000 lb. (20,412 kg.) A.U.W. 9,500 ft. (2,895 m.).

Required CAR runway length for T.O. at S/L. at max. T.O. weight 5,000 ft. (1,525 m.).

Required CAR runway length for landing at S/L. at 46,800 lb. (21,228 kg.) A.U.W. 4,010 ft. (1,222 m.).

THE CONVAIR-LINER 340.

Although based on the Model 240, the Convair-Liner 340 is largely a new aircraft with greater wing span and area, a longer fuselage, more powerful engines, greater all-up weight and many interior design improvements.

The fuselage of the 340 is the same diameter as that of the 240 but is 54 in. (1.37 m.) longer, achieved by inserting a 16 in. (0.40 m.) section forward and a 38 in. (0.96 m.) section aft of the wings. This extra length permits the introduction of four additional seats, or it can be used for cargo purposes.

The first Convair 340 flew on October 5, 1951, and the first delivery to an airline—United Air Lines—was made on March 28, 1952.

Among the civil users of the Convair-Liner 340 are United Air Lines, Braniff Airways, Delta Air Lines, Continental Air Lines, National Airlines, Hawaiian Airlines, Aramco, Garuda Indonesian Airways, Finnish Air Lines (Aero O/Y), Philippine Air Lines, K.L.M., Aeronaves de Mexico, Cia. Mexicana de Aviacion, Avensa (Venezuela), Jugoslovenski Aerotransport (JAT), Servicos Aereos Cruzeiro do Sul (Brazil), Alitalia, REAL (Brazil), Lufthansa, Saudi Arabian Airlines, The Texas Company, Phillips Petroleum Company, Pratt & Whitney Aircraft, Union Oil Company, Union Carbide Company and Union Producing Company.

The last two Convair 340's were delivered to REAL (Brazil) in January, 1955, bringing the total number built to 209.

One Model 340 has been re-engined with two Napier Eland turboprops by D. Napier and Son, who are offering Eland conversion kits to operators of Convair-Liner 340 and 440 aircraft.

A full structural description of the Convair-Liner 340 has appeared in previous editions of "All the World's Aircraft."

TYPE.—Twin-engined medium-range Airliner.

POWER PLANT.—Two Pratt & Whitney R-2800-CB16 eighteen-cylinder radial air-cooled engines, each rated at 1,800 h.p. at 8,500 ft. (2,590 m.) in low blower and 1,700 h.p. at 14,500 ft. (4,240 m.) in high blower and with 2,400 h.p. available for take-off (with water injection). Engines mounted in aerodynamically-clean nacelles incorporating what is known as "aspirated cooling." Air after passing through cylinder blocks enters a venturi section into which the exhaust gases are also ejected, the effect being to increase flow of cooling air. Air/exhaust mixture in a ratio of about 5/1 is ejected via twin tail-pipes above rear end of nacelle. Exhaust gas augmentation is claimed to give an increase in speed of about 10-12 m.p.h. (16-19.2 km.h.). Hamilton Standard Hydromatic constant-speed feathering and reversing airscrews, diameter 13 ft. 1 in. (4 m.). Integral fuel tanks outboard of engine nacelles. Maximum fuel capacity 1,750 U.S. gallons (6,615 litres). Provision for underwing refuelling.

ACCOMMODATION.—Crew of three/four. Cabin seats forty-four passengers in pairs on each side of central aisle.

DIMENSIONS.—
Span 105 ft. 4 in. (32.12 m.).
Length 79 ft. 2 in. (24.14 m.).
Height (over tail) 28 ft. 2 in. (8.59 m.).
Wing area 920 sq. ft. (85.5 m.²).

WEIGHTS AND LOADINGS.—
Weight empty 29,486 lb. (13,382 kg.).
Max. gross take-off weight 47,000 lb. (21,320 kg.).
Max. landing weight 46,000 lb. (20,884 kg.).
Max. T.O. wing loading 51.08 lb./sq. ft. (249.27 kg./m.²).
Max. T.O. power loading 9.8 lb./h.p. (4.44 kg./h.p.).

PERFORMANCE.—
Cruising speed (1,200 h.p. per engine) at 18,000 ft. (5,490 m.) 284 m.p.h. (448 km.h.).
Range with 200 miles (320 km.) plus ¾-hour reserve; 1,200 h.p. per engine; 10 m.p.h. (16 km.h.) head wind; 44 passengers and baggage; 1,157 U.S. gallons (4,373 litres) of fuel 2,015 miles (3,225 km.).
Max. CAR operating height with one engine inoperative 9,000 ft. (2,745 m.).
Required CAR runway length for T.O. at max. T.O. weight 4,675 ft. (1,425 m.).
Required CAR runway length for landing S/L. at max. landing weight 4,500 ft. (1,370 m.).

THE CONVAIR-LINER 240.

The Convair-Liner 240 was the first post-war commercial transport designed by Consolidated Vultee and was evolved primarily to serve as a DC-3 replacement. The prototype first flew at San Diego on March 16, 1947, and the first licenced aircraft was delivered to American Airlines on February 28, 1948.

Altogether, 176 Convair-Liner 240's were built, most of which were delivered to, and are still in service with, the following airlines:—American Airlines; Western Air Lines; Pan American World Airways; Canadian Pacific Air Lines; Linee Aeree Italiane (LAI); K.L.M. (Royal Dutch Airlines); Trans-Australia Airlines; Aerolineas Argentinas; Orient Airways (Pakistan); Mohawk Airlines; Sabena (Belgian Airlines); Northeast Airlines; Garuda Indonesian Airways, Ethiopian Airlines, Trans-Ocean Airlines, Civil Air Transport, Inc., Eagle Aviation, Ltd., Iranian Airways, Trans-Arabian and VARIG.

A full structural description of the 240 Convair-Liner has been published in previous editions of "All the World's Aircraft."

THE CONVAIR T-29.

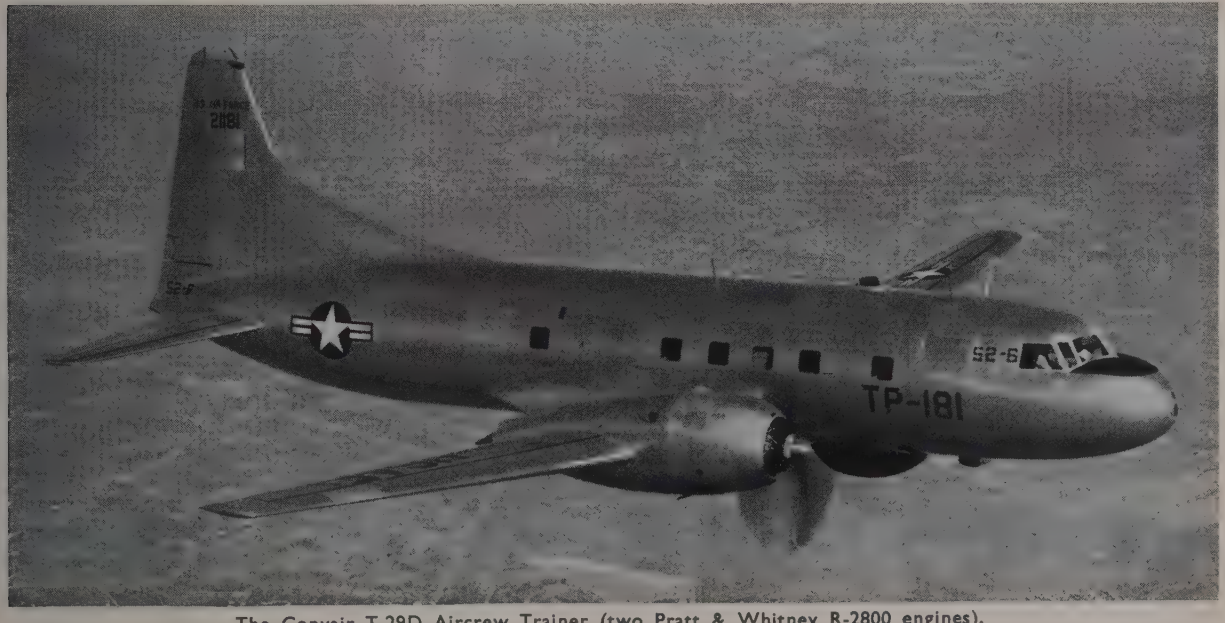
Military versions of the Convair 240 carry the designation T-29, of which the following versions have been built:—

T-29A. Original Convair-Liner 240 crew trainer conversion. Non-pressurised but fitted with oxygen equipment for high-altitude training, permitting 6 hour's duration at 20,000 ft. (6,100 m.) at 250 m.p.h. (400 km.h.). Cabin has fourteen fully-equipped stations for students and one radio operator's station. Each student has access to a map table, Loran scope, altimeter indicator and radio compass panel. In roof of fuselage are four astrodomes. Five drift-meters also included. First T-29A flew on September 22, 1949. All T-29A's later modified with additional outer wing fuel tanks for increased range at operational height. 48 built.

T-29B. Development of T-29A with pressurised cabin, increased fuel capacity and greater A.U.W. of 43,575 lb. (19,780 kg.) compared with 40,500 lb. (18,390 kg.) of T-29A. Major external difference is the fitting of three astrodomes and one periscopic sextant on top of fuselage instead of the four astrodomes of the A Series. First T-29B flew on July 30, 1952. 105 built.

T-29C. Similar to T-29B but fitted with two advanced model 2,500 h.p. Pratt & Whitney R-2800 engines. Accommodation for 14 students and instructors. First T-29C flew on July 28, 1953. About 20 of these aircraft, assigned to the Air Force Academy at Colorado Springs, are being fitted with two wingtip-mounted Fairchild J44 turbojets to provide improved take-off and climb performance at the high-altitude airfields used by the Academy. 119 built.

T-29D. Similar to T-29C but equipped for advanced navigation/bombardment



The Convair T-29D Aircrew Trainer (two Pratt & Whitney R-2800 engines).



The Convair C-131A Samaritan Transport (two 2,500 h.p. Pratt & Whitney R-2800-99W engines). (*Gordon Williams*).

training. Accommodation for six students and two instructors. Training equipment for all phases of radar and optical bombing and navigation, including use of the "K" system bombsight. Only external difference compared with T-29B is the absence of astrodomes. First T-29D flew on August 11, 1953. 93 built.

VT-29E. This designation covers four Convair-Liner 240 personnel transports for MATS use. Two are furnished for V.I.P. use and two have standard high-density seating.

The following data refers specifically to the T-29B which is powered with two 2,500 h.p. Pratt & Whitney R-2800-99W engines.

DIMENSIONS.—
Span 91 ft. 9 in. (27.98 m.).
Length 74 ft. 8 in. (22.77 m.).
Height over tail 27 ft. 3 in. (8.31 m.).
Wing area 817 sq. ft. (75.9 m.²).

WEIGHT.—
T.O. weight 43,575 lb. (19,780 kg.).

PERFORMANCE.—
Max. speed 300 m.p.h. (480 km.h.).
Average cruising speed 230 m.p.h. (368 km.h.).
Stalling speed (with flaps) 92 m.p.h. (147 m./min.).
Initial rate of climb 1,370 ft./min. (418 m./min.).
Service ceiling 24,000 ft. (6,320 m.).
Service ceiling on one engine 7,500 ft. (2,290 m.).
T.O. distance to 50 ft. (15.25 m.) 1,030 yds. (945 m.).
Landing distance from 50 ft. (15.25 m). 780 yds. (714 m.).
Cruising range 1,500 miles (2,400 km.).

THE CONVAIR C-131.

The C-131A Samaritan is a military transport version of the Convair-Liner 240. It was the first pressurised twin engined air-evacuation transport to be ordered by the Military Air Transport Service. 26 were built.

The cabin can be arranged to carry 37 passengers in backward-facing seats or 27 stretcher cases, or several combinations of both. For loading stretchers a large hydraulically-operated door, opening upwards, is provided on the port side of the cabin aft of the wings. A standard Convair-Liner integral stairway which folds into the aircraft is located on the starboard side forward of the wings.

The C-131A is powered by two 2,500 h.p. Pratt & Whitney R-2800-99W engines.

DIMENSIONS.—
As for Convair-Liner 240.

WEIGHTS.—
Weight empty 29,000 lb. (13,166 kg.).
Weight loaded 43,575 lb. (19,783 kg.).

PERFORMANCE.—
Max. speed 313 m.p.h. (500 km.h.).
Stalling speed 95.4 m.p.h. (153 km.h.).
Initial rate of climb 1,410 ft./min. (430 m./min.).
Service ceiling 24,500 ft. (7,470 m.).
Service ceiling on one engine 7,100 ft. (2,165 m.).
Range with max. fuel (1,530 U.S. gallons = 5,780 litres) 1,600 miles (2,560 km.).
Take-off distance to 50 ft. (15.25 m.) 1,100 yds. (1,006 m.).

Whereas the C-131A previously described is based on the Convair-Liner 240, there are several other aircraft in the C-131 series which are developments of the slightly larger Convair-Liner 340. These are :—

C-131B. This designation is applied to several aircraft which are used as flying laboratories to test electronic equipment, either by the Air Force itself for research projects or by firms engaged in the development of special electronic devices under Air Force contract. The C-131B is pressurised, has the Convair-Liner's integral passenger stairway forward of the wings, and is equipped with fittings to accommodate 48 passenger seats so that the aircraft can be quickly converted for transport duties. Large cargo door on port side of fuselage aft of wings for loading test equipment, etc. Provision for installation of radome beneath fuselage. 36 built.

One C-131B has been fitted with two Solar T41 gas-turbine units, mounted in special plastic and metal pods on pylons, one under each wing. It is the first aircraft to carry these units, which drive generators to supply electrical power to the aircraft, externally.

First C-131B flew for the first time on December 1, 1954.

DIMENSIONS.—
Same as for Convair-Liner 340.

WEIGHTS.—
Weight empty 29,000 lb. (13,166 kg.).
Weight loaded 47,000 lb. (21,340 kg.).

PERFORMANCE.—
Max. speed 305 m.p.h. (488 km.h.).
Cruising speed 276 m.p.h. (442 km.h.).
Service ceiling over 20,000 ft. (6,100 m.).
Range with max. fuel 1,900 miles (3,040 km.).

YC-131C. This designation covers two Convair-Liner 340's which are powered by two 3,750 h.p. Allison YT56-A-3 turboprop engines. They have been flown intensively by No. 1700 Test Squadron, as part of the U.S.A.F.'s turboprop test and evaluation programme. The gross weight of the YC-131C is 53,200 lb. (24,153 kg.), and it has an average true air speed of approximately 320 m.p.h. (515 km.h.), cruising at 21,000 ft. (6,400 m.).

The first YC-131C made its maiden flight on June 29, 1954.



The Convair YC-131C (two 3,750 s.h.p. Allison YT56 turboprop engines).



The Convair R4Y-1 Naval Transport (two 2,500 h.p. Pratt & Whitney R-2800-52W engines).

VC-131D. Military transport version of the Convair-Liner 340 for use in the Air Force's domestic transport service. 33 built. Last six incorporate modifications for speed improvement and sound reduction introduced in Model 440 (which see.)

TC-131E. Ten built as electronic countermeasure trainers for Strategic Air Command. Nine now being converted into air evacuation transports for M.A.T.S. Incorporates sound-proofing and speed improvements introduced in Model 440 (which see). Extruded magnesium floor stressed to 300 lb./sq. ft. 10-foot cargo door on port side aft of wing. Integral passenger stairway.

Five basically-similar C-131E aircraft with special equipment employed by the C.A.A. for testing facilities along the Federal Airways above 10,000 ft. (3,050 m.).

RC-131F. Similar to TC-131E. Six for Military Air Transport Service (MATS).

RC-131G. Similar to RC-131F. One for Military Air Transport Service.

THE CONVAIR R4Y.

U.S. Navy versions of the Convair 340 and 440 carry the designation R4Y, of which the following versions have been built :—

R4Y-1. Cargo / personnel / ambulance version of 340, with two 2,500 h.p. Pratt & Whitney R-2800-52W (Mod.) engines. Thirty-six for U.S. Navy. Reinforced plastic-covered extruded magnesium floor stressed to 300 lb./sq. ft. Tie-down rings in floor to withstand 6,000 lb. strain. 10-foot cargo door on starboard side. Integral passenger stairway. As personnel transport can carry 44 passengers in removable upholstered seats which can face either forward or backward. Seats are interchangeable with those used in R3Y flying-boat transport. Military bucket seats may also be installed. No galley or baggage compartment. Toilet at rear of cabin. As ambulance can carry 27 stretcher patients and as freighter its payload is 12,000 lb. Flight deck similar to 340. First production R4Y-1 flew on June 29, 1955.

R4Y-1Z. This is an executive transport version of the Convair-Liner 340 in service with the U.S. Navy. Seats 24 passengers and sleeps 6, plus crew. Based at the U.S. Naval Air Station, Anacostia.

Structurally, the R4Y-1 and R4Y-1Z are generally similar to the Model 440 (which see). Altogether, 36 were built.

R4Y-2. Two 440's used by the U.S. Navy Bureau of Aeronautics as combined transport and research aircraft.

DIMENSIONS.—
Same as for Convair Metropolitan 440.
WEIGHTS.—
Weight empty 30,464 lb. (13,918 kg.).
Weight loaded 47,000 lb. (21,319 kg.).
Landing weight 46,500 lb. (21,092 kg.).
PERFORMANCE.—
Max. speed at 16,000 ft. (4,875 m.) 294 m.p.h. (473 km.h.).
Cruising speed (1,200 h.p. per engine) at 20,000 ft. (6,100 m.) 289 m.p.h. (465 km.h.).
Landing speed 85 m.p.h. (137 km.h.).

DE LACKNER

DE LACKNER HELICOPTERS, INC.

HEAD OFFICE : 14, NORTH BLEEKER STREET, MOUNT VERNON, NEW YORK.
President : Donald de Lackner.
Vice-President : F. Faranda.

de Lackner Helicopters, Inc. is developing a single-place helicopter, originally known as the Heli-Vector and now named the Aerocycle. Soldiers are stated to have learned to control the prototype in 20 minutes.

THE DE LACKNER DH-5 AEROCYCLE.

Developed from the DH-4 Aerocycle, described in previous editions of this Annual, the new DH-5 version is a single-place helicopter in which the pilot and engine are located on a small platform above a pair of 15-foot (4.5 m.) contra-rotating rotors. Below the rotors is a tubular skid landing gear.

The Aerocycle is powered by a 40 h.p. Kiekhaefer Mercury Mark 55 two-stroke outboard motor which drives the rotors by means of a chain belt. An automatic torque-balancing unit and a clutch to permit autorotation are incorporated in the rotor drive.

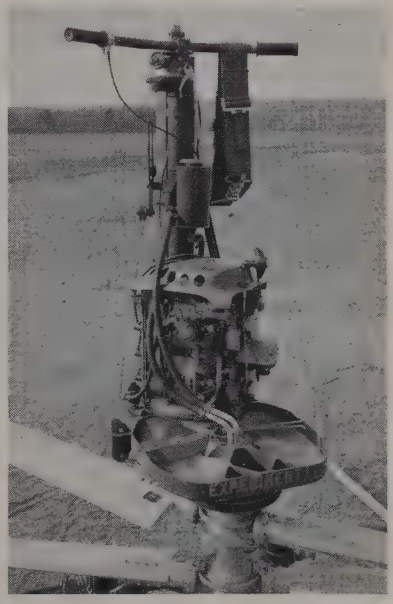
The pilot standing on the platform controls the Aerocycle by leaning his body in the required direction. He is provided with a control column to which he is lightly strapped. The column is topped by a pair of handle-bars the movement of which turns the platform to face in the right direction. A twist-grip control operates the engine throttle.

The hollow control column serves as the fuel tank and has a capacity of 2 U.S. gallons (7.56 litres).

No further details are yet available.



The de Lackner DH-5 Aerocycle. (*Howard Levy*).



The control stand of the de Lackner Aerocycle. (*Howard Levy*).

DETEMPLE

DETEMPLE HELICOPTERS, INC.

HEAD OFFICE: 3720, WEST SIXTH STREET, LOS ANGELES, CALIFORNIA.

Directors: Donald E. DeTemple (President and Chairman); Thomas E. DeTemple; Dr. Robert Fenton Craig (Secretary).

Vice-President: Frank Fennimore.

Treasurer: George W. Ott, Jr.

DeTemple Helicopters, Inc. was formed in October, 1957 to undertake the design and development of low-cost minimum-size helicopters for commercial and military applications. At present, its activities are concentrated mainly on development of single-seat and two-seat helicopters for the civil market, but the company's engineering department is working on studies concerned with the production of low-cost military helicopters for the U.S. Army, Navy, Marine Corps and Air Force.

Details of the DH-28, a two-seat civil helicopter under development by DeTemple Helicopters, Inc., are given hereafter. The prototype is scheduled to fly in 1960.

THE DETEMPLE DH-28.

TYPE.—Two-seat Light helicopter.

ROTOR SYSTEM.—Two two-blade contra-rotating main rotors of semi-rigid laminated wood construction. Main rotor disc area 153.94 sq. ft. (14.30 m.²). No anti-torque rotor.

ROTOR DRIVE.—Direct shaft from engine. Main rotor/engine r.p.m. ratio 3 : 1.

FUSELAGE.—Aluminium alloy and Fiberglas structure.

LANDING GEAR.—Non-retractable tail-wheel type.

POWER PLANT.—One 180 h.p. Lycoming O-360-A1A four-cylinder horizontally-opposed air-cooled engine. Fuel capacity 40 U.S. gallons (151.5 litres).

ACCOMMODATION.—Enclosed cabin seating two persons. Space for 75 lb. (34 kg.) baggage.

DIMENSIONS.—
Main rotor diameter 14 ft. (4.27 m.).
Overall length 14 ft. (4.27 m.).
Length of fuselage 12 ft. (3.66 m.).

WEIGHT.—
Weight loaded 1,225 lb. (555 kg.).

PERFORMANCE (estimated).—
Max. speed 97 m.p.h. (156 km.h.).
Cruising speed 75 m.p.h. (121 km.h.).
Range 250 miles (400 km.).

DOAK

DOAK AIRCRAFT COMPANY, INC.

HEAD OFFICE AND WORKS: 22.309 SOUTH WESTERN AVENUE, TORRANCE, CALIFORNIA.

President, General Manager and Chairman: Edmond R. Doak.

Vice-Presidents: E. E. Rosier and C. W. Morris.

Secretary-Treasurer: R. H. Parkin.

Chief Engineer: Norman E. Nelson.

Chief Aerodynamicist: James B. Reichert.

The Doak Aircraft Company was incorporated in 1940 and has since engaged in the manufacture of aircraft and aircraft assemblies. Since its inception, the company has also carried out considerable research and development in vertical take-off techniques, and the Doak Model 16 research aircraft described below is a product of this programme.



The Doak Model 16 in its horizontal take-off and flight configuration.

THE DOAK MODEL 16.

Under development for the U.S. Army Transportation Research and Engineering Command, the Doak Model 16 is a simply-constructed research aircraft with ducted airscrews on its wing-tips. These ducts can be rotated through 90°, enabling the airscrews to function as helicopter rotors for vertical take-off and landing and hovering. At a safe height after take-off, the ducts are rotated to the normal forward-facing attitude, making possible much higher cruising speeds than with a conventional helicopter. The fuselage remains horizontal at all times.

Construction of the Doak Model 16 is conventional, with a welded steel-tube fuselage and all-metal cantilever wing and tail unit. It is powered by an 840 h.p. Lycoming T53 shaft-turbine engine which is mounted in its fuselage behind the tandem seats for pilot and observer. The engine is fitted with a long tail-pipe and horizontal and vertical vanes appear to be hinged at the jet efflux to assist control during low-speed and vertical flight.

Military duties for which the Doak Model 16 would be suitable include observation, liaison and casualty evacuation in forward areas devoid of airfields. When airstrips are available, it can be operated as a conventional fixed-wing aircraft, with the ducts permanently in the forward-facing attitude and carrying increased payload or fuel.

Ground tests of the prototype began on February 25, 1958.

DIMENSIONS.—
Span 16 ft. 0 in. (4.88 m.).
Length 32 ft. 0 in. (9.75 m.).
Height 10 ft. 0 in. (3.05 m.).

WEIGHTS.—
Weight empty 2,000 lb. (907 kg.).
Weight loaded 2,600 lb. (1,180 kg.).

PERFORMANCE.—
Not available.



The Doak Model 16 with its ducted airscrews in the VTO position.

DOMAN

DOMAN HELICOPTERS, INC.

HEAD OFFICE AND WORKS: MUNICIPAL AIRPORT, DANBURY, CONNECTICUT.

Established: August 31, 1945.

President: Glidden S. Doman.

Vice-President, Purchasing: Raymond C. Dugan.

Director of Research and Development: Stephen du Pont.

Manager, Military Research and Development: John W. Mazur.

Treasurer: Arthur R. Tallardy.

Doman Helicopters, Inc. was formed to develop a helicopter embodying new principles established by its engineers. These include a hingeless rotor unit in which the blades are dynamically flexible but otherwise unarticulated, a hydraulic rotor control system, and a rotor mechanism contained within a housing with circulating oil lubrication provided for all moving parts.

The latest Doman helicopter, the LZ-5 made its first flight on April 27, 1953. C.A.A. certification was granted on December 30, 1955.

THE DOMAN LZ-5-2.

TYPE.—General Purpose Helicopter.

ROTOR SYSTEM.—One four-blade main rotor and one three-blade anti-torque and steering tail rotor. Main rotor of hingeless type, articulation for aerodynamic flapping being provided by gimbal-mounting the hub. A common housing encloses the reduction gearing, swashplate and rotor mechanism, with lubrication by circulating oil. Each blade has a spar of plastic-bonded birch laminates and a plastic-bonded mahogany ply covering. Entire leading-edge is armoured with nylon and the trailing-edge is of extruded nylon which serves as a trim-tab. Main rotor blade area (each) 18.4 sq. ft. (1.71 m.²). Total disc area 1,810 sq. ft. (168.2 m.²). Anti-torque rotor blades rigidly attached to gimbal-mounted hub. Total disc area of anti-torque rotor 78.5 sq. ft. (7.29 m.²).

FUSELAGE.—Welded steel-tube structure covered with magnesium and aluminium sheet.

LANDING GEAR.—Four-wheel type. Cleveland Pneumatic air-oil shock absorbers. Goodyear wheels and tyres, size 10.00 SO and 5.00-5. Tyre pressure 65 lb./sq. in. 4.57 kg./cm.²). Track 7 ft. 6 in. (2.29 m.). Wheelbase 7 ft. 9 in. (2.35 m.). Alternatively, pontoons or skids can be fitted.

POWER PLANT.—One 400 h.p. Lycoming SO-580-A1B eight-cylinder horizontally-opposed air-cooled engine mounted in nose of fuselage with crankshaft centre-line inclined up and aft at 32 degrees. Fluid drive with mechanical lock-up on engine crankshaft flange coupled to inclined tubular drive shaft equipped with universal joints. Tail rotor drive from take-off gear in main rotor. Main rotor/engine

r.p.m. ratio 14.59 : 1. Anti-torque rotor/engine r.p.m. ratio 3.154 : 1. Fuel tankage in floor beam structure of main cabin section. Total fuel capacity 119 U.S. gallons (450 litres). Oil capacity 7 U.S. gallons (26.5 litres).

ACCOMMODATION.—Pilot's compartment in nose above engine seating two side-by-side. Cabin may seat up to six or accommodate four stretchers. Seats are quickly-removable for freight-carrying. For certain bulk cargo operation such as crop-dusting and pipe-carrying, the fuselage covering and other non-structural parts may be removed to permit a useful load of 2,250 lb. (1,020 kg.) to be carried, within the C.A.A. certificated A.U.W. of 5,200 lb. (2,360 kg.). Cabin is 7 ft. 1 in. (2.16 m.) long, 5 ft. (1.52 m.) wide and 5 ft. 11 in. (1.82 m.) high. Non-structural windowed accordian doors of cabin easily detachable for loading bulky objects, giving a 7 ft. 1 in. (2.16 m.) wide access to the cabin.

DIMENSIONS.—
Main rotor diameter 48 ft. (14.64 m.).
Length of fuselage 37 ft. 10 in. (11.54 m.).
Overall width 5 ft. (1.52 m.).
Height (to top of rotor pylon) 10 ft. 5 in. (3.17 m.).
Anti-torque rotor diameter 10 ft. (3.05 m.)

WEIGHTS.—
Weight empty 3,250 lb. (1,475 kg.).
Disposable load 1,950 lb. (885 kg.).
Weight loaded 5,200 lb. (2,360 kg.).

WEIGHTS (stripped configuration).—
Weight empty 2,950 lb. (1,336 kg.).
Disposable load 2,250 lb. (1,020 kg.).
Weight loaded 5,200 lb. (2,360 kg.).



The Doman LZ-5-2 Helicopter (400 h.p. Lycoming SO-580 engine).

PERFORMANCE (at 5,200 lb. = 2,360 kg. A.U.W.).—
Max. speed 104 m.p.h. (166.4 km.h.).
Cruising speed 81 m.p.h. (130 km.h.).
Max. rate of climb 850 ft./min. (285 m./min.).
Hovering ceiling (in ground effect) 4,000 ft. (1,216 m.).
Service ceiling 11,500 ft. (3,496 m.).
Range with 10% fuel reserve 383 miles (616 km.).
Max. endurance 5.5 hours.

DOUGLAS

THE DOUGLAS AIRCRAFT COMPANY, INC.

HEAD OFFICE AND WORKS: SANTA MONICA, CALIFORNIA.

OTHER WORKS: EL SEGUNDO AND LONG BEACH, CAL.; TULSA, OKLAHOMA; AND CHARLOTTE, NORTH CAROLINA.

Established: 1920. (Reorganized: 1928).

Chairman: Donald W. Douglas.
President: Donald W. Douglas, Jr.
Vice-Chairman: Frederick W. Conant.
Vice-President—Engineering: A. E. Raymond.
Vice-President—Sales: Nat Paschall.
Vice-President—General Administration: John A. Dundas.
Vice-President—Public Relations: A. M. Rochlen.
Vice-President—Long Beach Division: K. G. Farrar,
Vice-President—Santa Monica Division: L. A. Carter.
Vice-President—El Segundo Division: H. G. Hynd.
Vice-President and Director, European Division: M. E. Oliveau.
Director of Transport Aircraft Systems Engineering: E. F. Burton.
Director of Combat Aircraft Systems Engineering: E. H. Heinemann.
Director of Missiles and Space Systems Engineering: E. P. Wheaton.
Executive Secretary: F. E. MacArthur.
Treasurer: Harry W. Strangman.

SANTA MONICA DIVISION.
General Manager: L. A. Carter.
Works Manager: N. H. Shappell.
Chief Engineer: S. Kleinhans.

EL SEGUNDO DIVISION.
General Manager: H. G. Hynd.
Works Manager: R. A. Myers.
Chief Engineer: L. J. Devlin.

LONG BEACH DIVISION.
General Manager: K. G. Farrar.
Works Manager: W. A. Burton.
Chief Engineer: Carlos C. Wood.

TULSA DIVISION.
Works Manager: J. L. Jones.
Chief Engineer: C. R. Strang.

CHARLOTTE DIVISION.
General Manager: S. P. Smith.
Works Manager: J. P. Rogan.
Chief Engineer: A. D. Jamtaas.

The Douglas Aircraft Company has occupied the present factory site at Clover Field, Santa Monica, Cal., since 1928. It also operates plants at El Segundo, nine miles from the main plant, at Long Beach, 25 miles away, at Tulsa, Oklahoma and at Charlotte, N.C.

The Santa Monica Division was responsible for the production of the DC-6 and DC-7. The last aircraft in the DC-6/DC-7 Series, a DC-7C (No. 1041) delivered to K.L.M. in 1958, was the last piston-engined aircraft built by Douglas.

The El Segundo Division continues to manufacture the A3D Skywarrior, the F4D Skyray, and A4D Skyhawk. Production of the AD-7 Skyraider, which has been described fully in earlier editions of "All the World's Aircraft," ended in February, 1956.

The Long Beach Division is responsible for the production of the DC-8 jet airliner, which is the subject of one of the most intensive programmes of engineering and production ever undertaken by private industry. The first production DC-8 was completed on April 9, 1958, and made its maiden flight on May 30, 1958. Long Beach is also handling production of the C-133A transport.

The Tulsa Division, a war-time bomber plant, was re-activated in 1951 to assist in the three-company production programme for the Boeing B-47 bomber. This work was completed in December, 1956 and the Tulsa Division subsequently produced a total of 55 RB-66C's and WB-66D's for the U.S.A.F.

The Douglas company is engaged on an extensive programme of development which includes conventional military aircraft of advanced design, guided missiles, rockets, etc.

In the missile field, the Charlotte factory is producing the Nike surface-to-air anti-aircraft rocket, while the Santa Monica factory is producing the Honest John free-flight surface-to-surface rocket missile for the Army Field Forces, and the Thor intermediate-range ballistic missile and the MB-1 Genie nuclear air-to-air missile for the U.S.A.F. All these weapons are described in the "Guided Missiles" section of this work.

THE DOUGLAS CARGOMASTER.

U.S.A.F. designation: C-133.

The C-133A is a four-engined transport which, although not very much bigger in overall dimensions than the C-124, can carry payloads equivalent to twice the normal cargo capacity of the C-124 Globemaster II. Detailed design work on the aircraft began in February, 1953. The first C-133A was completed in February, and made its first flight on April 23, 1956. By the end of January, 1957, three C-133A's had been delivered to Edwards Air Force Base for flight testing and a fourth to Wright-Patterson Air Force Base for climatic tests. The first operational C-133A was delivered on August 29, 1957.

The C-133A's main freight hold is 90 ft. (27.45 m.) long with the floor at truck-bed height. There are two loading doors and virtually all types of military vehicles can be driven up the integral ramp and through the main doors beneath the rear of the fuselage. Typical loads are two prime-movers weighing more than 40,000 lb. (18,160 kg.) each, 16 loaded Jeeps, 20 jet engines or various combinations of vehicles, heavy ordnance and general cargo. It can also accommodate the American IRBM and ICBM surface-to-surface missiles. Roller conveyors can be installed in existing fittings in the aircraft in approximately five minutes to speed the loading of heavy items of freight.

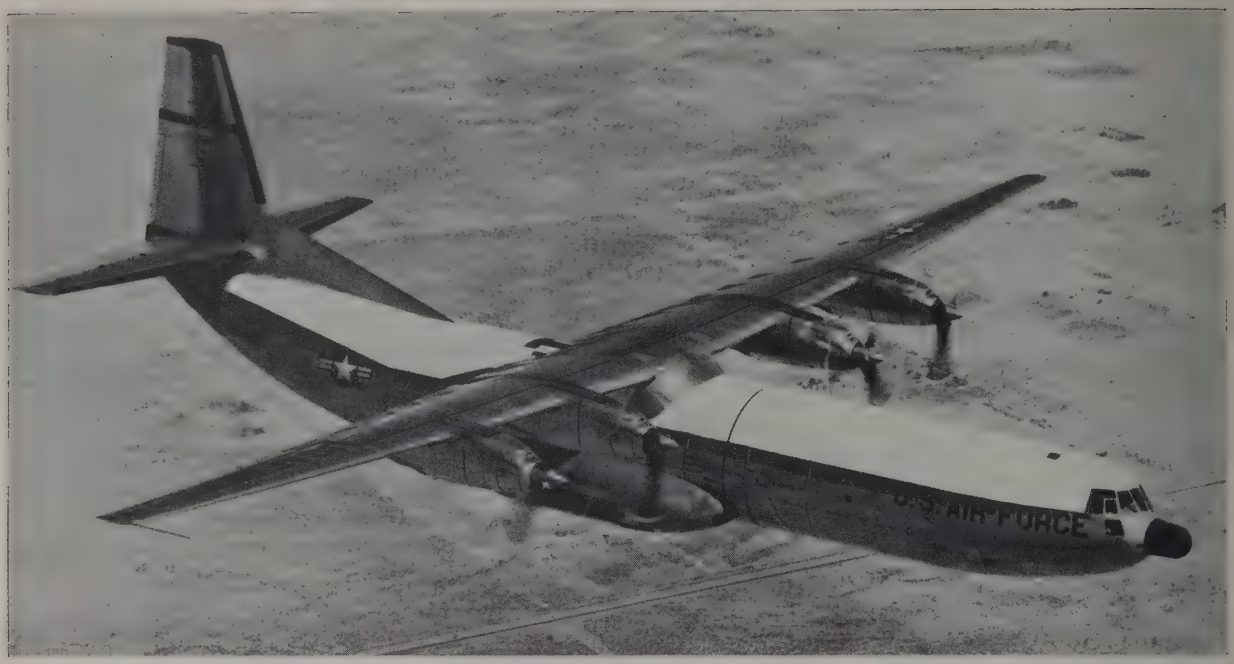
Although designed primarily for air freight, the basic configuration of the C-133A can easily be modified to permit the transportation of more than 200 fully-armed troops. It can also be used as an ambulance.

In June, 1958, a developed version designated the C-133B was announced. This version has four Pratt & Whitney T34-9W turboprop engines, a loaded weight of 286,000 lb. (129,730 kg.) and an enlarged main cargo door to permit easier loading of the Atlas ICBM and Thor and Jupiter IRBM's. It will carry more than 26 tons of cargo for 4,000 miles (6,435 km.) at 320 m.p.h. (515 km.h.). Fifteen C-133B's have been ordered, extending production into 1961.

TYPE.—Four turboprop-powered Long-Range Transport.

WINGS.—High-wing cantilever monoplane. Chord at tip 5 ft. 6½ in. (1.69 m.). Dihedral 2°. All-metal stressed-skin construction. Double slotted flaps between ailerons and fuselage. Thermal anti-icing system. Vortex generators on upper surfaces forward of ailerons. Total area of ailerons 143.3 sq. ft. (13.31 m.²). Total area of flaps 496.5 sq. ft. (46.13 m.²). Wing area 2,673.1 sq. ft. (248.3 m.²).

FUSELAGE. — All - metal semi - monocoque structure. Crew accommodation and



The Douglas C-133A Long-range Military Transport (four 6,000 e.h.p. Pratt & Whitney T34 turboprop engines).

freight hold pressurised to maintain 10,000 ft. (3,050 m.) cabin altitude to 35,000 ft. (10,675 m.).

TAIL UNIT.—Cantilever monoplane type. All-metal stressed-skin structure. Pneumatic boost de-icing system. Areas: fin 353.7 sq. ft. (32.86 m.²), rudder 183 sq. ft. (17.0 m.²), tailplane 459.2 sq. ft. (42.66 m.²), elevators 341.5 sq. ft. (31.73 m.²). Tailplane span 60 ft. (18.29 m.).

LANDING GEAR.—Retractable type. Steerable dual nose-wheel unit. Two main units of four wheels each retract into faired pods on sides of fuselage. Hydraulic actuation. Main tyres 20.00 × 20. Nose tyres 15.00 × 16. Wheel track 20 ft. 1 in. (6.12 m.). Wheelbase 58 ft. 11 in. (17.95 m.).

POWER PLANT.—Four 6,000 e.h.p. Pratt & Whitney T34-P-3 turboprop engines, each driving a Curtiss-Wright Turboelectric three-blade 18 ft. (5.49 m.) constant-speed reversing airscrew. Total fuel capacity 16,500 U.S. gallons (62,370 litres). Single-point pressure refuelling system with nozzle adapter in forward portion of starboard landing-gear pod. Engine starting by compressed air supplied by auxiliary gas-turbine installation located in port landing gear pod.

ACCOMMODATION.—Normal crew of six. Quarters for relief crew of three for extended operating. Usable hold is 90 ft. (27.45 m.) long and constant floor width is 11 ft. 10 in. (3.60 m.). Capacity of hold is 13,000 cub. ft. (368 m.³). Hold floor is 4 ft. 2 in. (1.27 m.) above ground. Loading doors in port side of fuselage forward and at rear of hold beneath fuselage. Main rear loading door in two sections, the lower section forming loading ramp, which is able to support a load of 25,000 lb. (11,340 kg.) in horizontal position and raise from ground with a 10,000 lb. (4,536 kg.) load. Doors, which are hydraulically-operated, are sealed to support full cabin pressure. Vehicles and other prime-movers up to 12 ft. (3.66 m.) high can drive into fuselage through rear door. Forward side door, 8 ft. 4 in. × 8 ft. 10 in. (2.54 m. × 2.69 m.) for direct loading of freight from truck or trailer. Entire accommodation pressurised and heated, the heating system having a capacity of 900,000 B.Th.U's. All pressurisation and ventilating requirements supplied by auxiliary dual gas-turbine power installation in port landing gear pod. Four automatically ejected and inflated life-rafts in centre-section, two on each side of fuselage and accessible from emergency exits. Separate life-raft for crew in forward fuselage.

DIMENSIONS.—
Span 179 ft. 8 in. (54.75 m.).
Length 157 ft. 6½ in. (48.0 m.).
Height 48 ft. 3 in. (14.70 m.).

WEIGHTS.—
Weight empty 111,715 lb. (50,680 kg.).
Weight loaded 255,000 lb. (115,770 kg.).
Overload gross weight 282,000 lb. (127,920 kg.).

PERFORMANCE.—
Normal cruising speed 311 m.p.h. (500 km.h.).
Range with 50,000 lb. (22,680 kg.) payload 4,030 miles (6,485 km.).
Range with 100,000 lb. (45,360 kg.) payload 1,300 miles (1,930 km.).

THE DOUGLAS GLOBEMASTER II.
U.S.A.F. designation: C-124.

The Globemaster II transport has the ability to load without disassembly 95 per cent. of all types of Army Field Force's equipment. It has nose-loading doors with vehicle ramps, a rear cargo hatch with elevator loading and auxiliary floor for double deck loading.

The last Globemaster II was delivered to the U.S.A.F. on May 9, 1955. In five years 446 C-124's were built at the Long Beach plant.



The Douglas C-124A Globemaster II Military Transport (four 3,500 h.p. Pratt & Whitney R-4360-20W engines).



The Douglas F4D-1 Skyray Interceptor (Pratt & Whitney J57 turbojet engine). (*Clay Jansson*).

The following versions of the Globemaster II were built :—

YC-124. Prototype. Four 3,000 h.p. Pratt & Whitney R-4360-35 engines driving four-blade airscrews. First flew on November 27, 1949.

C-124A. First production model. Four 3,500 h.p. Pratt & Whitney R-4360-20W engines driving Curtiss three-blade feathering and reversible airscrews 16 ft. 7 in. (5.06 m.) in diameter. Later fitted with thermal de-icing and APS-42 search radar as originally installed in C-124C.

YC-124B. One Globemaster fitted with four 5,500 h.p. Pratt & Whitney YT34-P-1 turboprop engines. Developed to provide technical data on the operation of turboprop propulsive systems and also to test the power-plant installation selected for the C-133. Flew for the first time on February 2, 1954. A.U.W. 200,000 lb. (90,800 kg.).

C-124C. Four 3,800 h.p. Ford-built Pratt & Whitney R-4360-63 engines. Development of C-124A. Fitted with APS-42 search radar in nose radome. Second production model. Production ceased in May, 1955.

One C-124 was modified to flight-test the Pratt & Whitney T57 turboprop engine, which was mounted in the nose of the fuselage.

A full structural description of the C-124 has appeared in previous editions of "All the World's Aircraft."

ACCOMMODATION.—Pilot's compartment seating two side-by-side in nose, with compartment immediately behind for flight-engineer, radio-operator and navigator. Galley, crew lavatory and relief crew compartment, with rest bunks, etc., further aft. Main cargo hold 77 ft. (23.48 m.) long, 12 ft. 10 in. (3.91 m.) high and 13 ft. (3.96 m.) wide, providing more than 10,000 cub. ft. (283 m.^{3}) of usable cargo space. Clamshell doors in nose ahead of nose-wheel provide an opening 11 ft. 8 in. (3.55 m.) high and 11 ft. 4 in. (3.45 m.) wide through which tracked or wheeled vehicles can be driven or rolled up built-in ramps. Electrically-operated elevator in middle of cargo hold, just aft of wing trailing-edge, provides additional loading and unloading facilities. Floor covered with 20 in. (50.8 cm.) grid pattern of heavy-duty tie-down fittings. Two overhead travelling cranes, each lifting 8,000 lb. (3,629 kg.) or 16,000 lb. (7,258 kg.) run length of hold. For personnel transport interior of hold can be converted into a double-deck cabin with capacity for 200 troops and their field equipment. Fitted as an ambulance it can accommodate 127 stretcher cases, plus 52 sitting patients and medical attendants.

DIMENSIONS.—
Span 174 ft. 1½ in. (53.10 m.).
Length 130 ft. 5 in. (39.77 m.).
Height 48 ft. 3½ in. (14.72 m.).

WEIGHTS.—
Payload 50,000 lb. (22,700 kg.).
Weight loaded 175,000 lb. (79,450 kg.).

PERFORMANCE.—
No data available.

THE DOUGLAS SKYRAY.
U.S. Navy Designation: F4D.

The F4D Skyray is a single-seat delta-wing tail-less monoplane which has been designed for the U.S. Navy as a supersonic carrier based interceptor fighter. The F4D was designed round the Westinghouse J40-WE-8 engine with afterburner, but owing to delays in the production of this engine the prototype XF4D-1 made its first flight on January 23, 1951, powered by an Allison J35-A-17 turbojet engine. It was later re-engined with the Westinghouse J40-WE-8.

On October 3, 1953, the XF4D-1 powered by a Westinghouse J40-WE-8 engine with afterburner, set up a World's Speed Record over the 3-km. course at Salton Sea, California, at 752.9 m.p.h. (1,211.746 km.h.).

The F4D-1 Skyray is in production at the El Segundo Division, powered by the Pratt & Whitney J57-P-2 turbojet engine (9,700 lb.=4,400 kg. s.t. without afterburner).

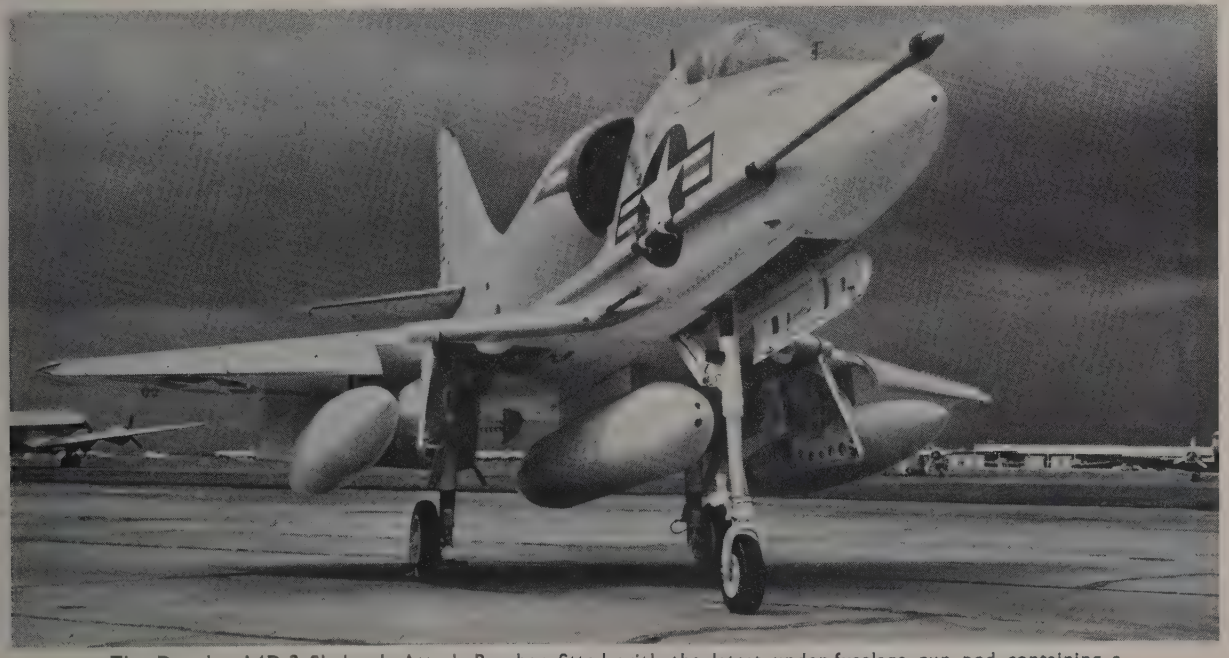
Armament consists of an unspecified number of 20 mm. cannon and there is provision for carrying various sizes and numbers of rocket packages or two bombs up to 2,000 lb. (908 kg.) under the wings. An Aero 13F fire-control system is fitted.

DIMENSIONS.—
Span 33 ft. 6 in. (10.21 m.).
Length 44 ft. 4 in. (13.43 m.).
Height 13 ft. (3.96 m.).
Wing area 557 sq. ft. (51.75 m.^{2}).

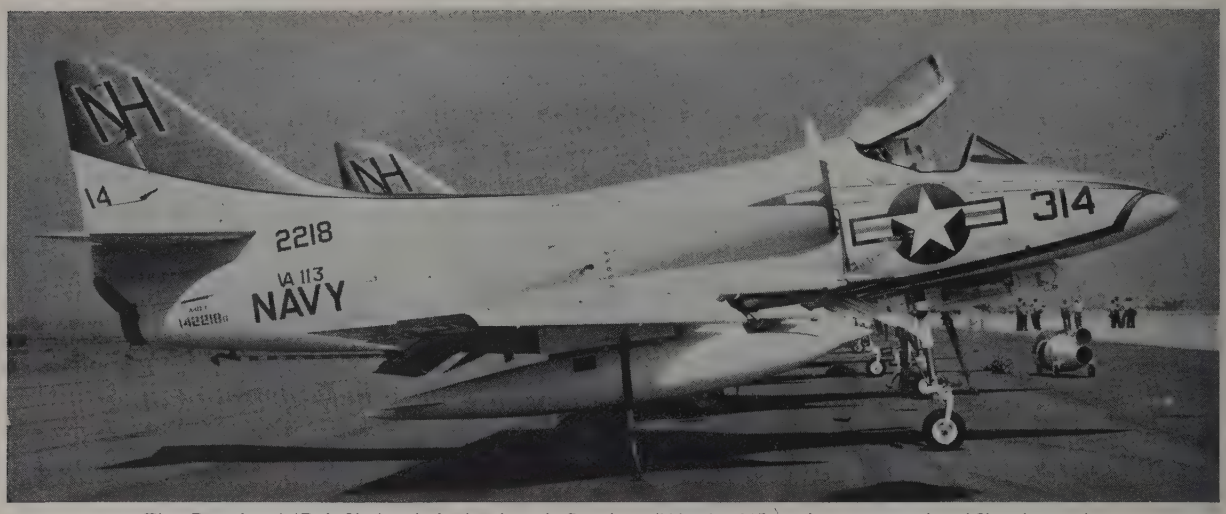
WEIGHT.
Loaded (approx.) 25,000 lb. (11,350 kg.).

THE DOUGLAS SKYHAWK.
U.S. Navy designation: A4D.

The Skyhawk is a single-seat light-weight attack bomber which is less than half the size of, and is superior in performance to, many current operational jet fighters. It is the smallest and



The Douglas A4D-2 Skyhawk Attack Bomber fitted with the latest under-fuselage gun pod containing a double-barrelled 20 mm. cannon.



The Douglas A4D-1 Skyhawk Light Attack Bomber (Wright J65 turbojet engine). (*Clay Janssen*).

lightest U.S. jet-powered combat aircraft ever built.

The maiden flight of the XA4D-1 powered by a Wright J65-W-2 engine (7,200 lb.=3,270 kg. s.t.) took place on June 22, 1954, two weeks after the aircraft was completed.

The following versions have been mentioned :—

A4D-1. Initial production version with Wright J65-W-4 turbojet engine (7,800 lb.=3,540 kg. s.t.). Entered service with U.S. Atlantic and Pacific Fleets in October, 1956.

A4D-2. Similar to -1 but fitted with single-surface rudder and powered tail.

Designed to operate from all sizes of aircraft-carrier and from short landing fields, the Skyhawk is of such dimensions that it will negotiate the standard aircraft carrier lift without the need for folding wings.

Its several hundred variations of military load can include nuclear weapons and air-to-air or air-to-surface guided missiles.

A Douglas-developed self-contained flight refuelling unit can be carried on the standard bomb shackles to enable the A4D to operate as a flying "tanker."

Designed on a completely functional basis with emphasis on simplification of structure and equipment, the first A4D was completed in eighteen months from the time the design work was started. As examples of weight-saving achieved, the air-conditioning system of the A4D is one-third the weight of the system previously used, while the pilot's ejector seat is almost one half the weight of the seat used in the A4D's predecessor. By design simplification the A4D gained 20 per cent. more in speed and a third more in range than was at first thought possible.

On October 15, 1955, the A4D established a World's Speed Record over the 500-km. closed circuit at Edwards AFB at 695.163 m.p.h. (1,118.67 km.h.).

TYPE.—Single-seat Attack bomber.

WINGS.—Low-wing cantilever monoplane. Chord at root 15 ft. 6 in. (4.72 m.). Sweepback 33° at 25% chord. All-metal three-spar structure. Spars machined from solid plate in one piece tip-to-tip. All-metal ailerons, with servo trim-tab in port aileron. All-metal split flaps. Automatic leading-edge slats with fences. Gross wing area 260 sq. ft. (24.16 m.²).

FUSELAGE.—All-metal semi-monocoque structure. Outwardly-hinged air-brake on each side of rear fuselage. Detachable nose over Packard-Bell packaged communications and navigation equipment.

TAIL UNIT.—Cantilever monoplane type. All-metal structure. Variable-incidence tailplane. Powered rudder of A4D-2 has unique central skin and external stiffeners. Area of vertical surfaces 50 sq. ft. (4.65 m.²). Area of horizontal surfaces 48.85 sq. ft. (4.54 m.²).

LANDING GEAR.—Retractable tricycle type. Menasco shock-absorbers. Legs pre-shorten for retraction. Hydraulic retraction.

POWER PLANT.—One 7,800 lb. (3,540 kg.) s.t. Wright J65-W-4 turbojet engine. Fuel in fuselage and integral wing tanks, total capacity 770 U.S. gallons (2,910 litres). Two 250 U.S. gallon (946 litre) or one 300 U.S. gallon (1,136 litre) auxiliary tank can be carried under wings or fuselage. A4D-2 has flight refuelling probe on starboard side of nose. Douglas-developed self-contained flight refuelling unit can be carried on standard bomb shackles.

ACCOMMODATION.—Pilot on lightweight (40 lb.=18 kg.) ejection seat.

ARMAMENT.—Two 20 mm. Colt cannon in wing roots. Provision for several hundred variations of military load, carried externally, including nuclear or H.E. bombs, air-to-surface rockets, Zuni or Mighty Mouse air-to-air rocket packs, Sidewinder infra-red missiles, Bullpup air-to-surface missiles, ground-attack gun pods, torpedoes, countermeasures equipment, etc. Central rack under fuselage carries up to 3,000 lb. (1,360 kg.) of stores. Each of the two under-wing racks carries 1,000 lb. (450 kg.).

DIMENSIONS.—
Span 27 ft. 6 in. (8.38 m.).
Length 39 ft. 1 in. (11.91 m.).
Height 15 ft. 2 in. (4.62 m.).

WEIGHT.—
Normal loaded weight 14,400 lb. (6,530 kg.).
Max. loaded weight (A4D-2) 15,500 lb. (7,030 kg.).

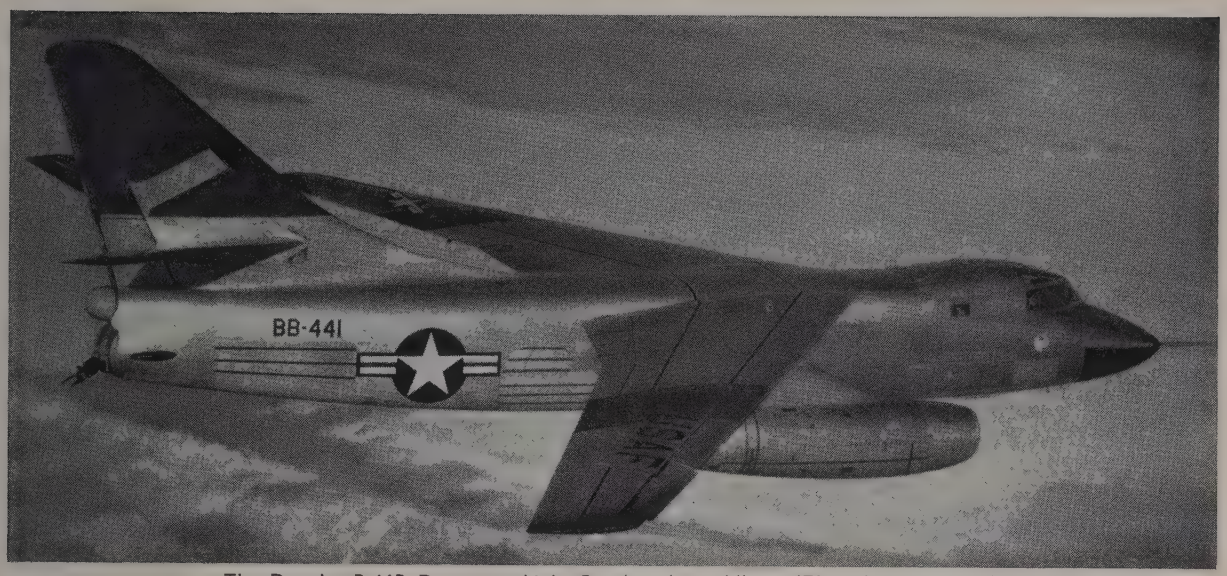
PERFORMANCE.—
Max. speed 680 m.p.h. (1,095 km.h.).
Max. range, internal fuel 1,150 miles (1,850 km.).

THE DOUGLAS SKYWARRIOR.
U.S. Navy designation: A3D.

The A3D is a twin-jet swept-wing carrier-based Attack Bomber which is able to operate off carriers of the "*Essex*," "*Midway*" and "*Forrestal*" classes. The most powerful aircraft ever designed for carrier operation, the A3D can carry the largest types of bombs, including nuclear weapons. It can be used for high-altitude high-speed attack



The Douglas A3D-1 Skywarrior Attack Bomber with wings and vertical tail surfaces being folded. (*Gordon Williams*).



The Douglas B-66B Destroyer Light Bomber (two Allison J71 turbojet engines).

or for low-level attack or mine-laying. It can also be adapted for photographic reconnaissance duties.

All A3D's have probes for in-flight refuelling and a special pack developed by Flight Refueling Inc., enables them to be adapted quickly for service as refuelling tankers.

The prototype XA3D-1 flew for the first time on October 28, 1952, powered with two Westinghouse J40 engines.

The A3D Skywarrior is in production at the El Segundo Division, and the first production aircraft flew for the first time on September 16, 1953.

Five versions have been announced :—

A3D-1. Initial production series with two Pratt & Whitney J57-P-6 turbojet engines (each 11,000 lb.=4,990 kg. s.t.) Entered service in April, 1956.

A3D-2. Developed version with Pratt & Whitney J57-P-10 turbojet engines. Entered service with U.S. Pacific Fleet early in 1957. Claimed to fly at high subsonic speeds above 40,000 ft. (12,200 m.).

A3D-2P. Photographic-reconnaissance version of A3D-2, with crew of three and 12 cameras. Re-designed and reinforced fuselage, pressurised to give equivalent of 8,000 ft. (2,440 m.) at 35,000 ft. (10,670 m.). Tail armament retained. Fuselage length 75 ft. 6 in. (23.0 m.). First flown on July 22, 1958.

A3D-2Q. Radar countermeasures version of A3D-2, with crew of seven and specialised equipment.

A3D-2T. Bombardier trainer, under development, with radar bomb sights and navigation gear. Accommodation for pilot, one instructor and six pupils. Tail armament retained.

TYPE.—Twin-jet Attack Bomber.

WINGS.—Shoulder-wing cantilever monoplane. 36° sweepback at 25% of chord. Aspect ratio 6.75. Taper ratio 6% at root, 8.25% at tip. Dihedral nil. All-metal two-spar torsion-box type structure. Outer wings fold upward hydraulically for carrier stowage. Hydraulically-operated NACA slotted flaps inboard of wing fold. Lateral control by combination of ailerons and spoilers on outer wings. Automatic leading-edge slats outboard of engine pod struts. Gross wing area 730 sq. ft. (67.82 m.²).

FUSELAGE.—All-metal structure in three sections, nose, centre and tail-cone. Air-brakes on sides of rear fuselage. Extendable anti-buffet "rake" forward of weapons bay.

TAIL UNIT.—All-metal cantilever monoplane type with all-moving tailplane. All surfaces swept. Vertical surfaces fold down to starboard for carrier stowage. Hydraulically-powered control system.

LANDING GEAR.—Retractable nose-wheel type. Nose-wheel retracts forward, main wheels sideways and backward, all into fuselage. Hydraulic actuation. Braking parachute stowed under rear gun turret. Retractable tail bumper and arrester hook. Wheel track 11 ft. (3.35 m.).

POWER PLANT.—Two Pratt & Whitney J57 turbojet engines in underwing pods. Fuel in four tanks, two self-sealing in fuselage, one forward and one aft of bomb-bay, and two integral wing tanks, one in each wing inboard of wing fold. Twelve 4,500 lb. (2,040 kg.) s.t. jettisonable T.O. rockets may be mounted on sides of rear fuselage.

ACCOMMODATION.—Crew of three, pilot and co-pilot/bombardier side-by-side and navigator/gunner behind pilot back-to-back, in pressurised cockpit. Emergency exit for all members of crew through floor escape chute of type first installed in F3D. Upper ditching hatch.

ARMAMENT.—Radar-directed Westinghouse Aero 21-B ball-turret in rear end of fuselage armed with two 20 mm. cannon. Bomb-bay 15 ft. (4.57 m.) long adaptable to carriage of variety of offensive stores.

DIMENSIONS.—
Span 72 ft. 6 in. (22.11 m.).
Length 73 ft. 6 in. (22.41 m.).
Height 22 ft. 9 in. (6.94 m.).

WEIGHTS.—
Weight empty approx. 38,000 lb. (17,240 kg.).
Normal loaded weight 70,000 lb. (31,780 kg.).
Overload weight 73,000 lb. (33,110 kg.).

PERFORMANCE (approx.).—
Max. speed 630 m.p.h. (1,014 km.h.).
Landing speed 167 m.p.h. (269 km.h.).
Service ceiling 45,000 ft. (13,720 m.).
Normal range 2,000 miles (3,220 km.).

THE DOUGLAS DESTROYER.

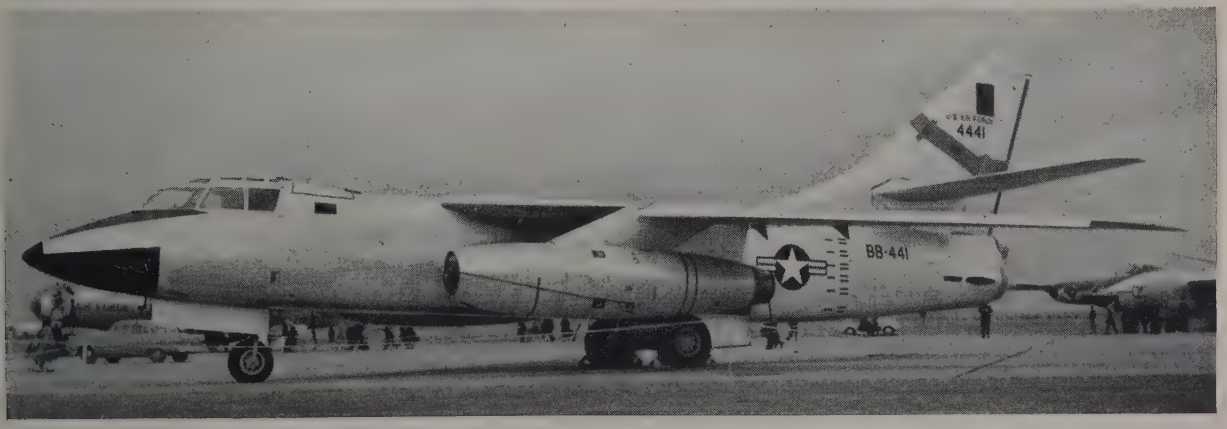
U.S.A.F. designations: B-66 and RB-66.

The B-66 three-seat high-performance light bomber, which is in production for the U.S.A.F., is based on the A3D previously described, with design and engineering changes to modify the carrier-based aircraft design into a land-based bomber.

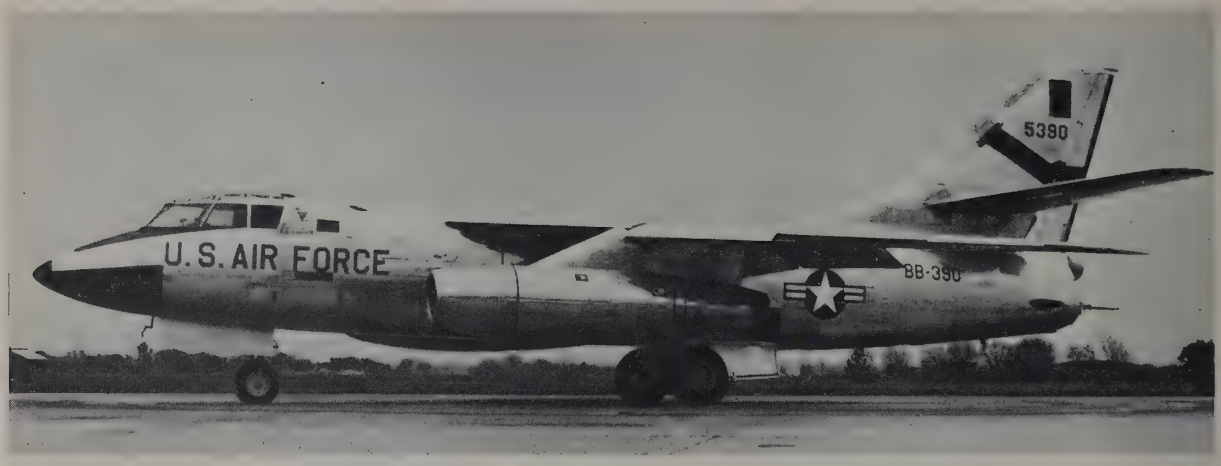
Versions of the basic B-66 so far announced are :—

RB-66A. First five production aircraft, used for service test only. Allison J71-A-9 turbojet engines. First RB-66A flew on June 28, 1954.

B-66B. First production bomber version, fitted with in-flight refuelling equipment. First B-66B flew on January 4, 1955. Early machines with Allison J71-A-9 turbojets; later models with J71-A-11. Deliveries to U.S.A.F. began on March 10, 1956.



The Douglas RB-66B, the reconnaissance version of the B-66B Light Bomber. (*J. D. Rawlings*).



The Douglas WB-66D, the Weather Reconnaissance version of the RB-66C.

RB-66B. Production development of RB-66A for night photographic reconnaissance, incorporating improvements introduced on B-66B. First RB-66B flew on June 28, 1954. Deliveries to U.S.A.F. started on February 1, 1956.

RB-66C. Development of RB-66B for all-weather electronics reconnaissance. In production. First RB-66C flew on October 29, 1955. Deliveries to U.S.A.F. started on May 11, 1956.

WB-66D. First production aircraft ever designed specifically for weather reconnaissance. Equipped with instruments to collect meteorological data over combat area or for normal Air Weather Service duties. Data fed into electronic computer to obtain complete weather report.

The RB-66 is in the 600-700 m.p.h. (965-1,126 km.h.) class and has a range of 1,500-1,750 miles (2,415-2,815 km.), but no other performance data is available for publication.

The structural description given for the A3D can be assumed to apply in general to the B-66. The information given below, however, refers primarily to the latter aircraft.

TYPE.—Twin-jet Bomber (B-66), Tactical Reconnaissance aircraft (RB-66) or Weather Reconnaissance (WB-66).

WINGS.—As for A3D but without wing folding. All-metal stressed-skin structure. All-metal single-slotted flaps. All-metal internal-pressure-balanced ailerons. Thermo-cyclic de-icing system. Areas: flaps (total) 108.8 sq. ft. (10.11 m.²), ailerons (total) 32.6 sq. ft. (3.03 m.²). Gross wing area 780 sq. ft. (72.5 m.²).

FUSELAGE.—Aluminium-alloy and magnesium semi-monocoque structure.

TAIL UNIT.—As for A3D but vertical surfaces non-folding. Thermo-cyclic de-icing to fin and tailplane. Areas: fin 129.9 sq. ft. (12.07 m.²), rudder 32.5 sq. ft. (3.02 m.²), tailplane 114.8 sq. ft. (10.66 m.²), elevators (total) 52.2 sq. ft. (4.85 m.²).

LANDING GEAR.—Retractable nose-wheel type. Hydraulic actuation. Air-oil shock struts designed by Douglas and manufactured by Cleveland Pneumatic Tool Co. Bendix disc brakes. Large ribbon braking parachute stowed under rear gun turret. Wheelbase 26 ft. 7¾ in. (8.11 m.). Track 10 ft. 10 in. (3.30 m.).

POWER PLANT.—Two Allison J71-A-11 turbo-jet engines (10,200 lb. = 4,627 kg. s.t. each) in underwing pods. Two wing and two fuselage tanks. Normal internal fuel capacity 4,650 U.S. gallons (17,580 litres). Auxiliary fuel in pylon-mounted underwing tanks, and provision for wing-tip tanks on RB-66C. Equipment for probe and drogue flight refuelling.

ACCOMMODATION.—Pilot seated in front of navigator and gunner. All three in ejector seats, with explosively-jettisonable roof hatches. Pressurised and air-conditioned. Normal pressure differential of 5 lb./sq. in. (0.35 kg./cm.²) reduced to 2.75 lb./sq. in. (0.19 kg./cm.²) for combat.

ARMAMENT AND EQUIPMENT.—Two 20 mm. cannon in tail ball-turret. General Electric electronic fire-control system. Provision for wide selection of bomb combinations, including nuclear weapons, in internal bay (B-66). Photographic equipment, comprising five cameras, photoflash bombs and cartridges, in RB-66. Meteorological instruments and computer in WB-66.

DIMENSIONS.—
Span 72 ft. 6 in. (22.11 m.).
Length 75 ft. 2 in. (22.9 m.).
Height 23 ft. 7 in. (7.18 m.).

WEIGHTS (B-66B).—
Weight empty 40,330 lb. (18,293 kg.).
Normal loaded weight 78,000 lb. (35,380 kg.).
Max. overloaded weight 83,000 lb. (37,648 kg.).

WEIGHTS (RB-66B).—
Weight empty 39,686 lb. (18,000 kg.).
Normal loaded weight 70,000 lb. (31,750 kg.).
Max. overloaded weight 79,000 lb. (35,834 kg.).

PERFORMANCE.—
No data available.

THE DOUGLAS DC-8.

The DC-8 is a four-jet swept-wing civil airliner with accommodation for 118-176 passengers.

The basic aeroplane will be available in a domestic version powered by either the Pratt & Whitney JT3C-6 (J57) or JT4A-3 (J75) turbojet engine, or in an inter-continental version with the JT4A-3 (J75) engine. Both versions are also available with the Rolls-Royce Conway by-pass engine.

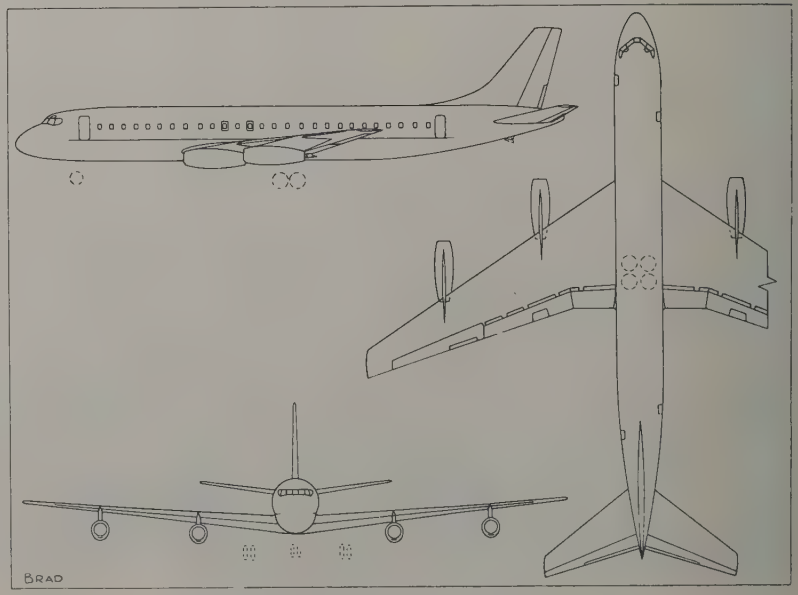
As all DC-8's will have the same overall dimensions, the aerodynamic characteristics and the location of major elements are identical. The electrical, hydraulic, control and air-conditioning systems will be uniform for all versions.

The intercontinental DC-8 will differ from the domestic version only in its added fuel capacity and the structural modifications needed to carry the additional fuel. The modifications are limited to the use of thicker skin and stringer material within the wing structure, the aft portion of the fuselage and the tailplane. The landing gear will also be more robust in the case of the heavier intercontinental version.

An extended-range version of the DC-8 was announced in June, 1958, with capacity for an additional 1,692 U.S. gallons (6,410 litres) of fuel, giving a range of 5,600 miles (9,000 km.) with a 26,500 lb. (12,020 kg.) payload and reserves. Powered by either JT4 or Conway turbojets, it will have a take-off weight of 310,000 lb. (140,610 kg.) and landing weight of 199,500 lb. (90,490 kg.).

At the time of writing the following airlines had placed firm orders for DC-8's: Eastern Airlines (20), Japan Airlines (4), K.L.M. (8), Pan American World Airways (21), Pan American-Grace Airways (4), SAS (7), Trans-Canada Air Lines (6), United Airlines (40), National Air Lines (3), Swissair (3), Delta Airlines (6), U.A.T. (2), T.A.I. (2), Olympic Airways (2), Trans-Caribbean Airways (1), Alitalia (4), Northwest Airlines (3) and Iberia (2).

There is no prototype of the DC-8 and the C.A.A. certification programme



The Douglas DC-8 Four-jet Airliner.

will be conducted with up to nine production aircraft, comprising three with JT3 engines, four with JT4 engines and two with Conway engines. The first DC-8 flew on May 30, 1958, and the target date for C.A.A. certification is August, 1959.

TYPE.—Four-engined Jet Airliner.

WINGS.—Swept-wing cantilever monoplane. 30° sweep. All-metal two-spar structure. Two double-slotted flaps on each wing. Power-operated ailerons in two portions, outer portions being operated from inner portions via torsion-bar springs. Self-coupling manual circuit to tabs on inner ailerons in event of power failure. Spoilers on top wing surface forward of flaps operate on nosewheel contact during landing. Gross wing area 2,758 sq. ft. (256.3 m.²).

FUSELAGE.—Double circular section all-metal structure.

TAIL UNIT.—Cantilever all-metal structure. Hydraulically-operated variable-incidence tailplane. Power-operated rudder with manual standby. Elevators manually-operated through tabs.

LANDING GEAR.—Retractable tricycle type. Main units are four-wheel bogies, the rear pair of wheels on each bogie being free to swivel in a sharp turn. Goodyear tyres, pressure 131 lb./sq. in. (9.21 kg./cm.²). Dual nose-wheel steerable through steering wheel and rudder pedals. Goodyear disc brakes. Wheel track 21 ft. 6 in. (6.55 m.).

POWER PLANT.—Four Pratt & Whitney JT3C-6 or JT4A-3 turbojet engines or four Rolls-Royce Conway R.Co.10 by-pass turbojet engines in four separate pods, two under each wing. All engines fitted with noise suppressors and thrust reversers for both ground and in-flight operation. All fuel in integral wing tanks with total capacity of 17,600 U.S. gallons (66,528 litres) on domestic versions and 21,615 U.S. gallons (81,705 litres) on intercontinental versions. Pressure refuelling. Powered fuel dumping at maximum rate of 1,800 U.S. gallons (6,815 litres) per minute.

ACCOMMODATION.—Normal seating for 118 persons in first class domestic versions and for 132 persons in mixed class intercontinental versions, with normal tourist accommodation for 144 and economy class seating for 176 in all versions. Mixed-class arrangements to suit requirements of customer. Windows, size 18.5 in. × 15 in. (0.47 × 0.38 m.) correspond with rows of first-class seats. Internal dimensions of cabin: length 102 ft. 1 in. (31.11 m.) maximum width 11 ft. 6 in. (3.50 m.) maximum height 7 ft. 3 in. (2.21 m.). Volume of freight and baggage compartments under cabin floor 1,390 cub. ft. (39.35 m.³).

DIMENSIONS.—
Span 139 ft. 9 in. (42.57 m.).
Length 150 ft. 6 in. (45.87 m.).
Height 42 ft. 4 in. (12.91 m.).

WEIGHTS AND LOADINGS (Domestic—P. & W. JT3C-6 (J57) engines).—
Weight empty (operating) 122,698 lb. (55,655 kg.).
Max. T.O. weight 265,000 lb. (120,310 kg.).
Design landing weight 189,000 lb. (85,810 kg.).
Capacity payload 33,040 lb. (14,987 kg.).
Max. wing loading 96.1 lb./sq. ft. (469.2 kg./m.²).

WEIGHTS AND LOADINGS (Domestic—P. & W. JT4A-3 (J75) engines).—
Weight empty (operating) 124,977 lb. (56,688 kg.).
Max. T.O. weight 265,000 lb. (120,310 kg.).
Design landing weight 189,000 lb. (85,810 kg.).
Capacity payload 33,040 lb. (14,987 kg.).
Max. wing loading 96.1 lb./sq. ft. (469.2 kg./m.²).

WEIGHTS AND LOADINGS (Intercontinental—P. & W. JT4A-3 (J75) engines).—
Weight empty (operating) 130,092 lb. (59,009 kg.).
Max. T.O. weight 287,500 lb. (130,525 kg.).
Design landing weight 194,000 lb. (87,997 kg.).
Capacity payload 35,680 lb. (16,184 kg.).
Max. wing loading 104.2 lb./sq. ft. (508.7 kg./m.²).

WEIGHTS AND LOADINGS (Intercontinental—Rolls-Royce Conway engines).—
Weight empty (operating) 128,082 lb. (58,097 kg.).
Max. T.O. weight 287,500 lb. (130,525 kg.).
Design landing weight 194,000 lb. (87,997 kg.).
Capacity payload 35,680 lb. (16,184 kg.).
Max. wing loading 104.2 lb./sq. ft. (508.7 kg./m.²).

PERFORMANCE (Domestic—P. & W. JT3C-6 (J57) engines).—
Recommended cruise at 220,000 lb. (99,800 kg.) A.U.W. at 30,000 ft. (9,150 m.) 561 m.p.h. (903 km.h.).
CAA field length required for T.O. at max. T.O. weight 9,130 ft. (2,785 m.).
Landing distance from 50 ft. (15.25 m.) at max. landing weight 4,010 ft. (1,222 m.).
Range with max. fuel at 534 m.p.h. (859 km.h.) with 21,900 lb. (9,933 kg.) payload, no allowances, 5,790 miles (9,318 km.).
Range with max. payload, no allowances 5,110 miles (8,224 km.).

PERFORMANCE (Domestic—P. & W. JT4A-3 (J75) engines).—
Recommended cruise at 220,000 lb. (99,800 kg.) A.U.W. at 30,000 ft. (9,150 m.) 589 m.p.h. (948 km.h.).
CAA field length required for T.O. at max. T.O. weight 7,320 ft. (2,230 m.).
Landing distance from 50 ft. (15.25 m.) at max. landing weight 3,970 ft. (1,210 m.).
Range with max. fuel at 550 m.p.h. (885 km.h.) with 25,600 lb. (11,612 kg.) payload, no allowances, 5,820 miles (9,366 km.).
Range with max. payload, no allowances, 5,350 miles (8,610 km.).

PERFORMANCE (Intercontinental—P. & W. JT4A-3 (J75) engines).—
Recommended cruise at 220,000 lb. (99,800 kg.) A.U.W. at 30,000 ft. (9,150 m.) 589 m.p.h. (948 km.h.).
CAA field length required for T.O. at max. T.O. weight 8,410 ft. (2,565 m.).
Landing distance from 50 ft. (15.25 m.) at max. landing weight 4,110 ft. (1,255 m.).
Range with max. fuel at 552 m.p.h. (888 km.h.) with 16,900 lb. (7,665 kg.) payload, no allowances, 6,880 miles (11,072 km.).
Range with max. payload, no allowances, 5,725 miles (9,214 km.).

PERFORMANCE (Intercontinental—Rolls-Royce Conway engines).—
Recommended cruise at 220,000 lb. (99,800 kg.) A.U.W. at 30,000 ft. (9,150 m.) 591 m.p.h. (951 km.h.).
CAA field length required for T.O. at max. T.O. weight 8,470 ft. (2,580 m.).
Landing distance from 50 ft. (15.25 m.) at max. landing weight 4,110 ft. (1,255 m.).
Range with max. fuel at 552 m.p.h. (888 km.h.) with 18,900 lb. (8,573 kg.) payload, no allowances, 6,880 miles (11,072 km.).
Range with max. payload, no allowances, 5,840 miles (9,400 km.).

NOTE.—All range and performance data pertains to specific payload and weights indicated, using long-range variable-altitude cruise techniques.

THE DOUGLAS DC-7.

The DC-7 is an evolutionary development of the DC-6 from which it differs mainly by having an 8 foot (2.44 m.) longer fuselage and a power-plant consisting of four 3,250 h.p. Wright Turbo Compound engines.

The DC-7 first went into service with American Air Lines on November 29, 1953.

TYPE.—Four-engined Airliner.

WINGS.— Low-wing cantilever monoplane. All-metal structure. Same as for DC-6. Gross wing area 1,463 sq. ft. (136 m.²).

FUSELAGE. — All-metal semi-monocoque structure as for DC-6.

TAIL UNIT.—Cantilever monoplane type. Same structure and areas as for DC-6.

LANDING GEAR.—Retractable tricycle type. Same as for DC-6 except wheelbase 36 ft. 2 in. (11 m.).

POWER PLANT.—Four 3,250 h.p. (T.O.) Wright R-3350-18DA1 Turbo Compound eighteen-cylinder radial air-cooled compounded engines, each driving a four-blade Hamilton Standard high activity airscrew 13 ft. 6 in. (4.1 m.) diameter. Fuel in eight wing tanks. Fuel capacity 5,512 U.S. gallons.



The second Douglas DC-8 and the first for United Air Lines emerging from the Long Beach factory.



The Douglas DC-7 Airliner (four 3,250 h.p. Wright R-3350-18DA1 Turbo Compound engines).

ACCOMMODATION.—Similar to DC-6. Crew of three (domestic) or five (oversea) plus cabin attendants. Accommodation for 60 passengers, plus six lounge seats in de-luxe version, or up to 95 in coach version. Automatically controlled air-conditioning and pressurisation to provide S/L atmosphere at 12,500 ft. (3,810 m.) equivalent of 5,000 ft. (1,525 m.) at 20,000 ft. (6,100 m.) and equivalent of 8,000 ft. (2,440 m.) at 25,000 ft. (7,625 m.). All freight and baggage space below cabin floor. Total cargo capacity 743 cub. ft. (21.0 m.^{3}) or 14,200 lb. (6,441 kg.).

DIMENSIONS.—
Span 117 ft. 6 in. (35.81 m.).
Length 108 ft. 11 in. (33.24 m.).
Height 28 ft. 7 in. (8.72 m.).

WEIGHTS.—
Weight empty 66,306 lb. (30,076 kg.).
Payload (standard seating) 20,600 lb. (9,344 kg.).
Max. T.O. weight 122,200 lb. (55,429 kg.).
Max. landing weight 97,000 lb. (43,998 kg.).

PERFORMANCE.—
At 97,000 *lb.* = 43,998 *kg. A.U.W.*
Max. speed 410 m.p.h. (656 km.h.) at 22,200 ft. (6,767 m.).
Max. cruising speed 365 m.p.h. (584 km.h.) at 24,400 ft. (7,437 m.).
Stalling speed 100 m.p.h. (160 km.h.).
Rate of climb at S.L. 1,760 ft./min. (536 m./min.).
Rate of climb at 20,000 ft. (6,100 m.) 990 ft./min. (302 m./min.).
Service ceiling 27,900 ft. (8,504 m.).
Ceiling on three engines 23,900 ft. (7,285 m.).
At 102,000 *lb.* = 46,266 *kg. A.U.W.*
Max. speed 406 m.p.h. (653 km.h.) at 22,100 ft. (6,736 m.).
Max. cruising speed 360 m.p.h. (579 km.h.) at 24,300 ft. (7,406 m.).
Stalling speed 102.4 m.p.h. (164.8 km.h.).
Rate of climb at S.L. 1,620 ft./min. (494 m./min.).
Rate of climb at 20,000 ft. (6,100 m.) 870 ft./min (265 m./min.).
Service ceiling 27,100 ft. (8,260 m.).
Ceiling on three engines 22,900 ft. (6,980 m.).
At 110,000 *lb.* = 49,895 *kg. A.U.W.*
Max. speed 401 m.p.h. (645 km.h.) at 22,000 ft. (6,706 m.).
Max. cruising speed 349 m.p.h. (562 km.h.) at 24,000 ft. (7,315 m.).
Stalling speed 106.3 m.p.h. (171 km.h.).
Rate of climb at S.L. 1,520 ft./min. (463 m./min.).
Rate of climb at 20,000 ft. (6,100 m.) 690 ft./min. (210 m./min.).
Service ceiling 25,900 ft. (7,894 m.).
Ceiling on three engines 21,400 ft. (6,523 m.).

RANGES.—
At 15,000 *ft.* = 4,575 *m.*
With 5,512 U.S. gallons (20,865 litres) fuel 4,430 miles (7,130 km.).
At 23,500 *ft.* = 7,163 m.
With 5,512 U.S. gallons (20,865 litres) fuel 3,905 miles (6,285 km.).

THE DOUGLAS DC-7B.

The DC-7B, the long-range intercontinental version of the DC-7 from which it differs in many respects.

The most important design change is a new flap linkage system which provides optimum position of the flap for take-off. By a re-location of the flap and vane with reference to the upper wing surface, the airflow characteristics over the flap have been improved, resulting in greater lift and reduced drag.

The fuel capacity has been increased from the 5,512 U.S. gallons of the DC-7 to 6,400 U.S. gallons by the addition of external saddle tanks which form part of the engine nacelles above the wing.

The power-plant of the DC-7B consists of four Wright Turbo Compound R-3350-18DA4 engines, each of which delivers 100 more METO horsepower than the earlier DA engines.

Cabin interiors are available to accommodate from 40 passengers in a *de luxe* version to 95 in the air-coach version.

DIMENSIONS.—
Same as for DC-7.

WEIGHTS.—
Weight empty 67,995 lb. (30,842 kg.).
Payload (standard seating) 22,650 lb. (10,274 kg.).
Max. T.O. weight 122,000 lb. (55,430 kg.).
Max. landing weight 102,000 lb. (46,265 kg.).

THE DOUGLAS DC-7C SEVEN SEAS.

The DC-7C is an improved version of the long-range DC-7B. It has a span of 127 ft. 6 in. (38.8 m.), 10 ft. (3.05 m.) more than that of the DC-7 and DC-7B. The extra span is added at the wing roots, the effect of which is to locate the inboard engines a further 5 ft. (1.5 m.) away from the fuselage. The increased span also gives space for additional fuel. The fuselage length has been increased by 40 in. (1.0 m.) forward of the wings. The vertical tail surfaces have been increased 2 ft. (0.6 m.) in height.

At the time of going to press, the following airlines had ordered the DC-7C: P.A.A. (25), Swissair (5), Sabena (10), SAS (14), Braniff (7), B.O.A.C. (10), K.L.M. (10), Alitalia (4), Mexicana (4), Northwest (14), T.A.I. (3), J.A.L. (4), Panair do Brasil (4), REAL Aerovias (3), Olympic (3).

TYPE.—Four-engined Intercontinental Airliner.

WINGS.—Low-wing cantilever monoplane. Wing section NACA 23016 at root, 2301476 at joint, 23012 at tip. Aspect ratio 9.93 Chord 17 ft. 11 in. (5.46 m.) at root, 5 ft. 11.3 in. (1.80 m.) at tip. Dihedral 7°.



The Douglas DC-7B Long-Range Airliner (four 3,350 h.p. Wright R-3350-18DA4 Turbo Compound engines).



The Douglas DC-7C Long-Range Airliner (four 3,400 h.p. Wright R-3350-18EA1 Turbo Compound engines).

Incidence 4° at root and joint, 1° at tip. Three-spar all-metal structure. Double-slotted all-metal flaps. Total area of flaps (including vane) 269.2 sq. ft. (25.0 m.²). Total area of ailerons (aft of hinge-line) 93.4 sq. ft. (8.67 m.²). Gross wing area 1,637 sq. ft. (152.0 m.²).

FUSELAGE. — All - metal semi - monocoque structure.

TAIL UNIT.—Cantilever monoplane type. Two-spar all-metal structure. Areas: fin 120.4 sq. ft. (11.18 m.²), rudder (aft of hinge, including tab) 53.7 sq. ft. (4.98 m.²), tailplane 210.9 sq. ft. (19.59 m.²), elevators (total, aft of hinge-line) 108.9 sq. ft. (10.11 m.²). Tailplane span 46 ft. 6 in. (14.13 m.).

LANDING GEAR.—Retractable nose-wheel type with twin wheels on main units. Steerable nose-wheel. Cleveland air-oil shock-absorber struts. Hydraulic retraction. Goodrich nose-wheel. Goodyear main wheels and Goodyear disc brakes. Tubeless tyres, size 17.00 × 20 on main units, 15.00 × 16 on nose-wheel. Wheelbase 39 ft. 5½ in. (12.05 m.). Track 34 ft. 8 in. (10.57 m.).

POWER PLANT.—Four Wright R-3350-18EA1 Turbo Compound radial air-cooled engines. Ratings: T.O. 3,400 h.p. at sea level; METO 2,800 h.p. low blower at sea level and 2,850 h.p. low blower at 4,300 ft. (1,310 m.); max. cruise 1,900 h.p. at 14,800 ft. (4,515 m.) low blower, 1,800 h.p. at 24,400 ft. (7,440 m.) high blower. Hamilton Standard Hydromatic 34E60-345 constant-speed reversible four-blade airscrews with electric anti-icing. Diameter 14 ft. (4.27 m.). Fuel in eight wing tanks. Total capacity 7,824 U.S. gallons (29,575 litres). Oil capacity 246 U.S. gallons (920 litres).

ACCOMMODATION.—Varied internal arrangements are supplied from a 62 passenger combination dayplane/sleeper version to a 99-passenger tourist version. Usual over-water crew consists of captain, first officer, flight engineer, navigator and radio-operator. Two crew bunks are provided for long flights. Seats for two cabin attendants with third seat optional. Capacities of cargo compartments 13,440 lb. (6,100 kg.) lower, 5,000 lb. (2,270 kg.) upper.

DIMENSIONS.—
Span 127 ft. 6 in. (38.8 m.).
Length 112 ft. 3 in. (34.23 m.).
Height 31 ft. 8 in. (9.65 m.).

WEIGHTS (typical loading).—
Manufacturer's weight empty 72,763 lb. (33,034 kg.).
Operating weight empty 78,890 lb. (35,785 kg.).
Passengers (62 at 165 lb.=75 kg.) 10,230 lb. (4,645 kg.).
Cargo (at 10 lb./cub. ft.) 6,510 lb. (2,956 kg.).
Fuel (7,086 U.S. gallons=26,785 litres) 42,517 lb. (19,303 kg.).
Oil (220 U.S. gallons=823 litres) 1,650 lb. (749 kg.).
Max. T.O. weight 143,000 lb. (64,865 kg.).
Max. landing weight 109,000 lb. (49,490 kg.).

PERFORMANCE.—
Max. speed, rated power high blower, at 22,700 ft. (6,925 m.) at 107,000 lb. (48,535 kg.) A.U.W., 406 m.p.h. (653 km.h.).
Recommended max. cruising speed (1,800 h.p. per engine) at 21,600 ft. (6,585 m.) and 110,000 lb. (49,900 kg.) A.U.W. 346 m.p.h. (557 km.h.).
Stalling speed at landing weight 97 m.p.h. (156 km.h.).
Rate of climb at 20,000 ft. (6,100 m.) at max. A.U.W. 240 ft./min. (73 m./min.).
Service ceiling at max. A.U.W. 21,700 ft. (6,615 m.).
Service ceiling on 3 engines at 107,000 lb. (48,535 kg.) A.U.W., 22,300 ft. (6,795 m.).
Service ceiling on 3 engines at max. A.U.W. 14,600 ft. (4,450 m.).
CAA take-off field length at S/L. at max. A.U.W. 6,360 ft. (1,940 m.).
Landing distance from 50 ft. (15.25 m.) 5,100 ft. (1,555 m.).
Range with max. fuel and 15,310 lb. (6,945 kg.) payload at 274 m.p.h. (441 km.h.) mean at 15,000 ft. (4,570 m.) in still air, no allowances 5,635 miles (9,070 km.).
Range with max. payload, still air, no allowances 4,635 miles (7,460 km.).

THE DOUGLAS DC-6.

TYPE.—Four-engined Airliner.

WINGS.—Low-wing cantilever monoplane. Wing section NACA 23016-23012. Incidence at root 4°. Dihedral 7°. All-metal structure with smooth Alclad skin. NACA slotted flaps inboard of ailerons. Thermal de-icing.

FUSELAGE. — Semi - monocoque all - metal structure with flush-riveted Alclad skin.

TAIL UNIT.—Cantilever monoplane type. Fin area 93.4 sq. ft. (8.67 m.²), Rudder area (aft of hinge, with tab) 49 sq. ft. (4.55 m.²), Total vertical area 159.9 sq. ft. (14.86 m.²), Tailplane area 210.9 sq. ft. (19.59 m.²), Elevator area (aft of hinge, with tab) 108.9 sq. ft. (10.11 m.²).

LANDING GEAR.—Retractable tricycle type. Hydraulic retraction with emergency manual gear. Hydraulic wheel brakes. Steerable nose wheel. Track 24 ft. 8 in. (7.52 m.). Wheelbase 30 ft. 8 in. (9.34 m.).

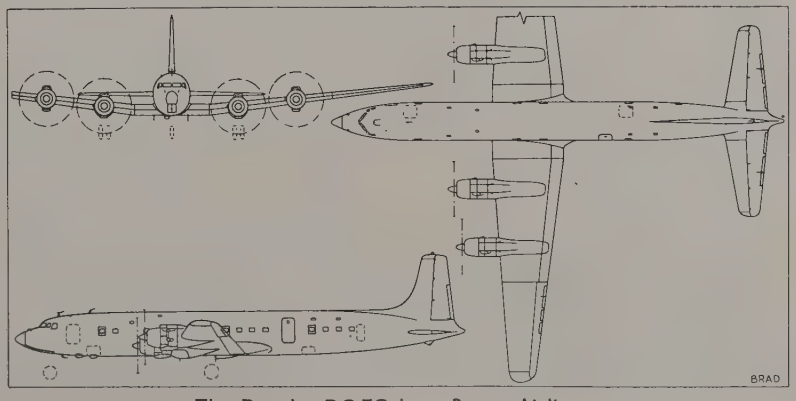
POWER PLANT.—Four Pratt & Whitney Double-Wasp R-2800-CA15 eighteen-cylinder two-row radial air-cooled engines, each normally rated at 1,800 h.p. at 6,000 ft. (1,830 m.), 1,600 h.p. at 16,000 ft. (4,880 m.) and with a take-off output of 2,100 h.p. without or 2,400 h.p. with water injection. Hamilton Standard three-blade constant-speed full-feathering and reversible airscrews 13 ft. 1 in. (3.98 m.) diameter. Fuel capacity from 3,322 to 4,700 U.S. gallons (12,560 to 17,770 litres).

ACCOMMODATION.— Pressurised accommodation for crew and passengers. Passenger compartment seats 48 by day and for short-range can accommodate up to a maximum of 58. Entrance vestibule with coat-room and galley aft of wings with cabin space fore and aft. Upper and lower berths of 26 to 39 passengers may be fitted up in 30 seconds. Upper berths have separate air-conditioning controls. All berths have reading lights and storage space for clothing and toilet accessories. Men's lounge and toilet forward of main cabin, ladies' lounge, etc. aft of main cabin. Entire cabin space has fiberglas sound-proofing and floors covered with foam-rubber-backed carpets. Pressurisation ensures cabin pressure altitude of approximately 5,000 ft. (1,525 m.) when flying at 16,000 ft. (4,880 m.), or 8,000 ft. (2,440 m.) when flying at 20,000 ft. (6,100 m.). Passenger cabin dimensions 64 ft. (19.5 m.) long 7 ft. 3 in. (2.2 m.) high. All freight and baggage space below cabin floor with new handling facilities to permit quick loading and unloading.

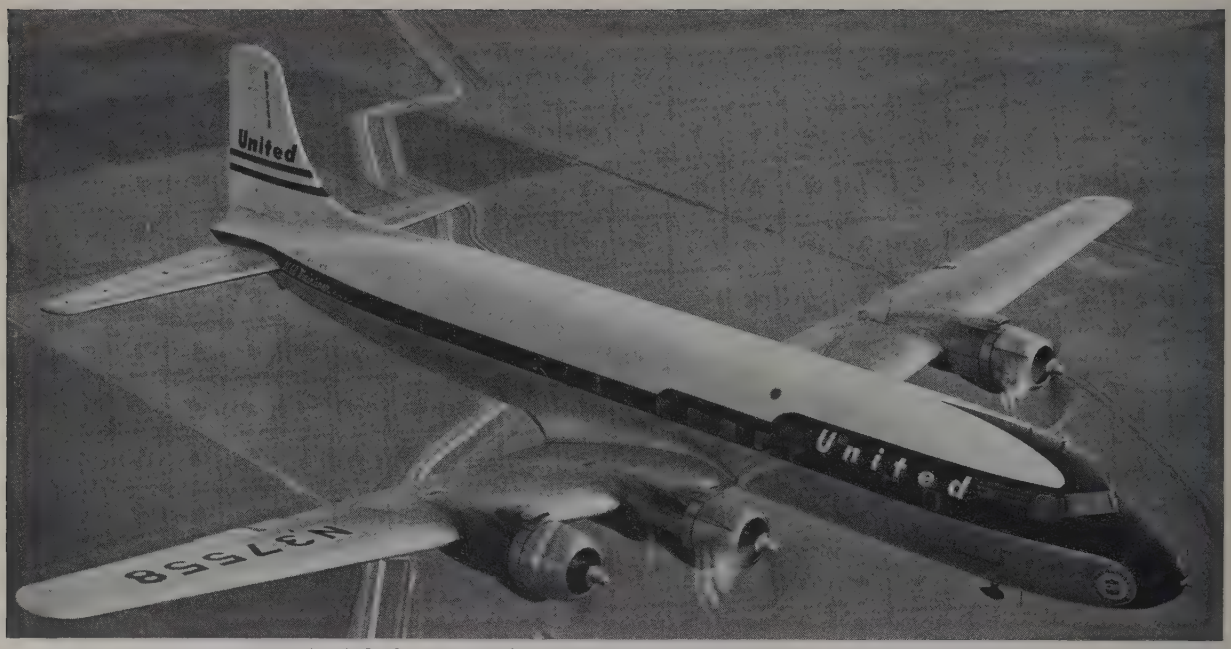
DIMENSIONS.—
Span 117 ft. 6 in. (35.81 m.).
Length 100 ft. 7 in. (30.66 m.).
Height (overall) 28 ft. 5 in. (8.66 m.).

WEIGHTS AND LOADINGS.—
Weight empty 51,495 lb. (23,380 kg.).
Weight loaded 97,200 lb. (44,130 kg.).
Wing loading 66.4 lb./sq. ft. (324 kg./m.²).
Power loading 10.1 lb./h.p. (4.58 kg./h.p.).

PERFORMANCE.—
Max. speed 356 m.p.h. (570 km.h.) at 19,600 ft. (5,980 m.).
Cruising speed 313 m.p.h. (501 km.h.) at 20,400 ft. (6,220 m.).
Landing speed 91 m.p.h. (145.6 km.h.).
Rate of climb at S/L. 1,070 ft./min. (326 m./min.).
Rate of climb at S/L. (one engine inoperative) 560 ft./min. (171 m./min.).



The Douglas DC-7C Long-Range Airliner.



The Douglas DC-6B Airliner (four 2,500 h.p. Pratt & Whitney R-2800-CB17 engines).

Normal range 3,820 miles (6,112 km.).
Max. range 4,610 miles (7,376 km.).
Take-off distance to 50 ft. (15.25 m.) S/L. (no wind) 1,240 yds. (1,133 m.).
Landing distance from 50 ft. (15.25 m.) 2,860 ft. (872 m.).
Landing distance from 50 ft. (15.25 m.) with reversible airscrews 2,150 ft. (656 m.).

THE DOUGLAS DC-6A.

U.S. Air Force designation: C-118.
U.S. Navy designation: R6D-1.

The DC-6A is a freight-carrying version of the standard DC-6. It uses the wings, tail-unit and landing-gear of the DC-6 but has an entirely new fuselage incorporating features which experience has shown to be necessary for successful military and commercial cargo operation.

The new fuselage is 5 ft. (1.525 m.) longer than that of the DC-6, giving the DC-6A a total cargo space of 5,000 cub. ft. (141.5 m.³). The main cabin, of constant cross-section throughout, is 68 ft. (20.74 m.) long, 7 ft. 9 in. (2.36 m.) high, and 8 ft. 9 in. (2.67 m.) wide at floor level. Two large doors, one forward and the other aft of the wings, are hinged at their top edges and swing upward to be clear of loading equipment. A self-powered loading elevator, which folds up for storage within the aircraft, can be attached to either front or rear cargo door and will lift 4,000 lb. (1,820 kg.) from truck-bed height to cabin floor level.

The DC-6A has automatically controlled cabin pressurisation and air-conditioning systems to permit high-altitude transportation of perishable cargoes.

Production of the military versions of the DC-6A—the C-118 and C-118A for the U.S.A.F. and the R6D-1 for the U.S. Navy—came to an end on December 29, 1955, after one C-118, 101 C-118A's and 65 R6D-1's had been delivered. These transports, which are in service with MATS and the U.S. Navy Fleet Logistic Air Wings, can carry 74 passengers, or 60 stretcher cases or 27,000 lb. (12,260 kg.) of cargo. The take-off weight is 107,000 lb. (48,530 kg.).

Power Plant.—Four Pratt & Whitney Double-Wasp R-2800-CB17 eighteen-cylinder radial air-cooled engines each developing 1,900 h.p. at max. continuous cruise and with 2,500 h.p. available for take-off with alcohol-water injection. Hamilton Standard or Curtiss Electric full-feathering and reversible airscrews. Standard fuel capacity 3,992 U.S. gallons (15,111 litres), with optional capacities of 5,406 U.S. gallons (20,550 litres) and 5,512 U.S. gallons (20,918 litres).

Dimensions.—
As for DC-6 except Length 105 ft. 7 in. (32.20 m.).

Weights and Loadings.—
Weight empty 49,767 lb. (22,595 kg.).
Gross T.O. weight 106,000 lb. (48,125 kg.)
Wing loading 72.5 lb./sq. ft. (353.8 kg./m.²)
Power loading 10.6 lb./h.p. (4.81 kg./h.p.).

Performance.—(At 95,000 lb.=42,800 kg. gross weight).—
Max. speed 360 m.p.h. (576 km.h.) at 18,100 ft. (5,520 m.).
Cruising speed 307 m.p.h. (494 km.h.) at 22,400 ft. (7,390 m.).
Landing speed 93 m.p.h. (149 km.h.).
Initial rate of climb 1,120 ft./min. (374 m./min.).
Initial rate of climb (one engine out) 620 ft./min. (203 m./min.).
T.O. distance to 50 ft. (15.25 m.) at max. A.U.W. (no wind) 4,500 ft. (1,492 m.).
Landing distance from 50 ft. (15.25 m.) 3,010 ft. (918 m.).
Landing distance from 50 ft. (15.25 m.) with reversible airscrews 2,250 ft. (686 m.).
Normal range 3,860 miles (6,176 km.).
Max. range 4,910 miles (7,856 km.).

THE DOUGLAS DC-6B.

The DC-6B is a passenger version of the DC-6A. The larger fuselage offers approximately 7% greater payload capacity and 14% greater passenger capacity than the standard DC-6, with only 4% greater operating costs.

The standard domestic dayplane version of the DC-6B carries 64 passengers, eight more than the standard DC-6, while a trans-oceanic model with larger galleys, coatrooms and toilet compartments carries 54 passengers instead of the present DC-6 limit of 48. A high-density 92-passenger version with an air-coach type interior is also available.

The DC-6B is available with either the Pratt & Whitney R-2800-CB17 or R-2800-CB16 power-plants. With the CB17 power-plant the maximum take-off weight is 106,000 lb. (48,125 kg.) and the performance is the same as for the DC-6A. With the CB16 power-plant which has 2,400 h.p. available for take-off, the maximum take-off weight is 100,000 lb. (45,400 kg.) and the corresponding take-off distance over a 50 ft. (15.25 m.) obstacle with no wind is 3,780 ft. (1,153 m.). The cruising and landing performance are the same as for the DC-6A. The empty weight of the standard DC-6B is 54,148 lb. (24,583 kg.) and the maximum landing weight is 88,200 lb. (40,043 kg.).

The version of the DC-6B supplied to Pan American World Airways has been specially modified for use on that operator's tourist class services. Pan American has acquired a fleet of forty-five aircraft of this type, which it calls the Super 6.

The Super 6, which has been certificated for a gross take-off weight of 107,000 lb. (48,580 kg.), carries a greater payload, has an increased fuel capacity and an improved performance. It has a standard accommodation for 82 passengers for trans-Atlantic tourist class operations.

FAIRCHILD

FAIRCHILD ENGINE AND AIRPLANE CORPORATION.

Executive Office: Hagerstown, Maryland.

Chairman of the Board: Sherman Fairchild.

President: Richard S. Boutelle.

Vice-President and General Manager, Missiles-Aircraft Division: Willard L. Landers.

Corporate Vice-President for Co-ordination of Planning and Product and Market Development: F. E. Newbold, Jr.

Corporate Vice-President for Commercial Transport: James H. Carmichael.

Corporate Vice-President for Communications: Richard C. Palmer.

Secretary: Paul S. Cleaveland.

Treasurer: Floyd S. Bennett, Jr.

FAIRCHILD MISSILES-AIRCRAFT DIVISION

Divisional Office and Works (Aircraft): Hagerstown, Maryland.

Divisional Office and Works (Missiles): Wyandanch, Long Island, N.Y.

General Manager: Willard L. Landers.

Assistant General Manager: O. A. Berthiaume.

Manager of Engineering: T. H. Beck.

Chief Engineer: Walter Tydon.

FAIRCHILD ENGINE DIVISION

Divisional Office and Works: Deer Park, Long Island, N.Y.

General Manager: Evard M. Lester.

Chief Engineer: Alfred T. Gregory.

STRATOS DIVISION

Divisional Office and Works: Bay Shore, Long Island, N.Y.

General Manager: J. W. Livingston.

Chief Engineer: D. O. Moeller.

FAIRCHILD ELECTROTECHNICS DIVISION.

DIVISIONAL OFFICE AND WORKS : COSTA MESA, CALIFORNIA.

General Manager : Howard E. Roberts.

Development Project Director : Bernard Fink.

The Fairchild Engine and Airplane Corporation was formed in 1936 to acquire from the Fairchild Aviation Corporation its aeroplane and aero-engine manufacturing subsidiaries.

The company's Aircraft Division was scheduled to complete production of the Fairchild C-123B assault and logistics transport for the U.S. Air Force by mid-1958, but is building the prototype of a new four-turboprop utility transport known as the Turboboxcar as a follow-on type. It is also the largest of some 2,000 sub-contractors on the Boeing B-52 production programme and is building fuselage sections, vertical tail fins and outer wing panels for this aircraft.

On the civil side, the Aircraft Division is manufacturing the Fokker F-27 Friendship turboprop airliner under licence, and the first production Fairchild-built F-27 flew for the first time on April 15, 1958.

The Aircraft Division holds research and development contracts for a VTOL aircraft known as the M-224-1, an advanced high-speed drone and several missile projects. Plans to produce a 10-seat executive jet transport known as the Model M-185 have, however, been abandoned.

The Guided Missiles Division is developing weapon systems and related equipment for the U.S. Navy, Air Force and Army. It is producing the guidance system for the Aircraft Division's Bull Goose missile, of which details are given in the "Guided Missiles" section of this work.

The Fairchild Engine Division is engaged in research and development work for the U.S. Navy and Air Force. In production are the lightweight J44 and J83 turbojets, and the latter is believed to power the Bull Goose missile. Details of these engines are given in the "Gas-Turbines" section of this work.

The Stratos Division specializes in the design and production of pressurization and cooling equipment for aircraft. The division is producing in volume compact air cycle refrigeration units for use in high-speed jet aircraft.

THE FAIRCHILD M-224-1.

Under development for the U.S. Army, the M-224-1 is an experimental vertical take-off aircraft employing the "blown flap" technique. It has a conventional high-wing monoplane configuration, with non-retractable tricycle landing gear, an open cockpit for the pilot in the fuselage nose and a braced T-type tailplane.



An artist's impression of the Fairchild M-224-1 Experimental VTOL aircraft.

The wing is fitted with full-span leading-edge flaps of large area. On its leading-edge are mounted four airscrews, shaft-driven from a single shaft-turbine engine installed above the fuselage. A small tail rotor is provided to assist control during vertical and low-speed flight.

No other details were available at the time of writing, except that the prototype was scheduled to fly towards the end of 1958.

THE FAIRCHILD F-27.

Fairchild are manufacturing under licence in America the Fokker F-27 twin-turboprop airliner. By the Summer of 1958, they had firm orders from West Coast Airlines (6), Mackey Airlines (2), Piedmont Airlines (8), Bonanza Air Lines (6), Quebecair (2), Aerovias Ecuatorianas (1), Northern Consolidated Airlines (5), Avensa (5), Wien Alaska Airlines (3), Wheeler Airlines (4), Pacific Airlines (5), LAV (6), Trans Mar de Cortes (Mexico) (2), Trans Pacific Airlines, Hawaii (3), unannounced airlines (4) and private corporations (13).

The first Fairchild-built F-27 flew for the first time on April 15, 1958.

There are three versions of the civil F-27. These are :—

F-27. Standard version powered by two Rolls-Royce RDa.6 Dart 511 engines. Standard seating for 40 passengers.

F-27A. Same as F-27 but fitted with more powerful RDa.7/1 528 engines.

F-27B. F-27 fitted with cargo-loading doors forward of wings.

In addition to civil airline and "executive" versions of the F-27, Fairchild are offering a military version, modified to make it suitable for carrying heavy freight and to be easily convertible into a personnel transport for 36 troops or casualty evacuation aircraft accommodating 24 litters and attendants.

The major modifications include enlargement of the forward freight door to 91.5 in (2.32 m.) in width and 70 in. (1.78 m.) in height, without altering the "truck-bed" height of the floor above ground level. A heavier floor is fitted, to support a maximum uniformly-distributed load of 200 lb./sq. ft. (975 kg./m.²), or 1,300 lb./linear ft. (1,935 kg./linear m.), in the forward half of the cabin, and a maximum uniformly-distributed load of 100 lb./sq. ft. (487 kg./m.²) or 650 lb./linear ft. (967 kg./linear m.) in the rear half of the cabin. The floor grid pattern consists of four rows of tie-down fittings, with side-wall tie-down rings on a level with the bottom of the windows.

Other proposed applications of the military F-27 include aerial photography and mapping, "flying command post" operation, weather reconnaissance, and flying-classroom duties to meet the requirements of the Air Force Academy.

In general, the Fairchild F-27 is similar to the Fokker-built version described in the Netherlands section of this work. Details of the main differences are as follows :—

LANDING GEAR.—Goodyear wheels and pneumatic brakes, with Westinghouse anti-skid system.



The Fairchild F-27 Airliner (two Rolls-Royce Dart 511 turboprop engines).

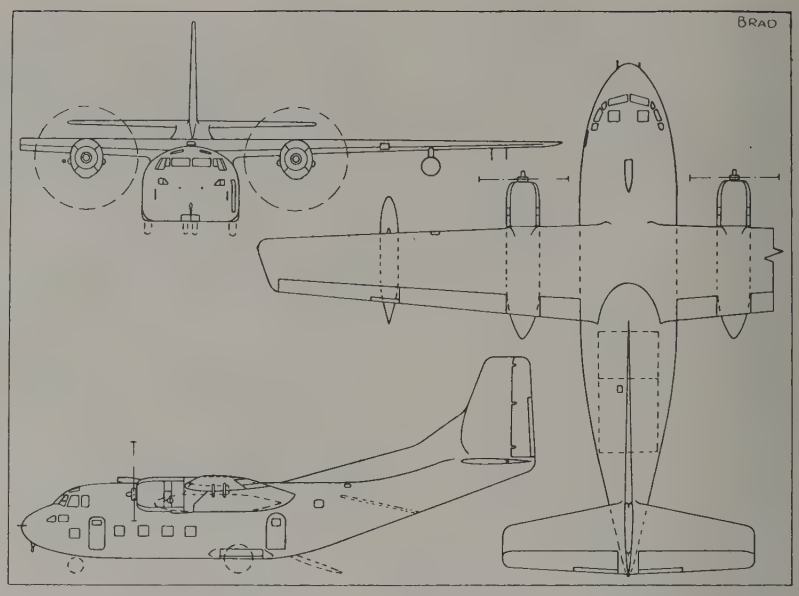
POWER PLANT.—Two fuel tanks in outer wings with capacity of 660 U.S. gallons (2,500 litres) each. Provision for two tanks in centre-section with capacity of 170 U.S. gallons (645 litres) each. Total fuel capacity 1,320 U.S. gallons (5,000 litres) or 1,606 U.S. gallons (6,290 litres). Oil capacity 7.5 U.S. gallons (28.4 litres).
ACCOMMODATION.—Standard seating for 40 passengers.
DIMENSIONS.—
Span 95 ft. 2 in. (29.0 m.).
Length 77 ft. 1½ in. (23.5 m.).
Height 27 ft. 6 in. (8.4 m.).
WEIGHTS.—
Weight empty 22,237 lb. (10,086 kg.).
Max. loaded weight 35,700 lb. (16,194 kg.).
Max. landing weight 34,000 lb. (15,422 kg.).
PERFORMANCE (at 33,000 lb.=14,970 kg. A.U.W.).—
Cruising speed at 20,000 ft. (6,100 m.) with 13,660 r.p.m. 280 m.p.h. (451 km.h.).
Rate of climb at S/L with 13,800 r.p.m. 1,400 ft./min. (427 m./min.).
Rate of climb, single engine at 5,000 ft. (1,525 m.) with 14,200 r.p.m. 3.50 ft./min. (107 m./min.).
Service ceiling at 14,200 r.p.m. 32,000 ft. (9,750 m.).
Single-engine service ceiling at 14,200 r.p.m. 13,000 ft. (3,960 m.).
Take-off field length at S/L (CAR4p) 4,070 ft. (1,240 m.).
Landing field length at S/L (CAR4p) 3,200 ft. (975 m.).
Range with 45 min. reserve (airline) 1,697 miles (2,730 km.).
Range with 45 min. reserve (executive) 2,500 miles (4,020 km.).

THE FAIRCHILD TURBOBOXCAR.

Fairchild is building the prototype of a new four-turboprop utility transport aircraft known as the Turboboxcar, as a successor to the C-119 Packet and C-123 assault transport. First flight was scheduled for late-1958.

The Turboboxcar will be powered by four 1,600 e.h.p. Lycoming T55 turboprops, and may feature boundary layer control. It is intended for operation from small fields and from the decks of aircraft carriers for on-board delivery service.

WEIGHTS.—
Weight loaded 75,000 lb. (34,020 kg.).
Max. payload 32,181 lb. (14,603 kg.).
PERFORMANCE (estimated).—
Cruising speed 249 m.p.h. (400 km.h.).
Ceiling 25,000 ft. (7,620 m.).
Take-off distance to 50 ft. (15.25 m.) 2,240 ft. (683 m.).
Take-off distance to 50 ft. (15.25 m.) with boundary layer control 1,750 ft. (533 m.).
Landing distance from 50 ft. (15.25 m). 2,050 ft. (625 m.).



The Fairchild C-123B Provider.

Landing distance from 50 ft. (15.25 m.) with boundary layer control 1,610 ft. (490 m.).
Range with 21,439 lb. (9,725 kg.) payload 1,500 miles (2,415 km.).

THE FAIRCHILD PROVIDER.

U.S.A.F. designation: C-123B.

The C-123 was designed by the original Chase Aircraft Company, Inc. A production order for 300 C-123B's held by the Kaiser-Frazer Corporation, which had acquired a majority interest in the Chase company in 1953, was cancelled in June of that year. New bids were asked for, as the result of which production of the C-123B was assigned to Fairchild. The first Fairchild-built C-123B flew for the first time on September 1, 1954, and production aircraft entered service with the U.S.A.F.'s 309th Troop Carrier Group in July, 1955.

Orders totalling more than 300 aircraft were completed in mid-1958. Most of these C-123B's are serving with the U.S.A.F.; but six are in service with the Saudi-Arabian Air Force and 18 with the Venezuelan Air Force.

An interesting design feature is that all fuel is carried in jettisonable tanks to reduce fire risk in combat.

In 1955, the prototype C-123B was fitted experimentally with two Fairchild J44 turbojet engines (1,000 lb.=454 kg. s.t. each) mounted at the wing-tips to provide auxiliary power for use in emergency, particularly in the event of failure of one engine on take-off. In tests the C-123B, loaded to its gross all-up weight and with one engine feathered during take-off, showed an increase in rate of climb of from 150 ft./min. to 500 ft./min. with the jet augmenters in operation.

Another C-123B was fitted with a wheel/ski landing gear, on which it took off and landed successfully at a loaded weight of approximately 56,000 lb. (25,400 kg.).

As a result of these private research projects, the U.S.A.F. had ten of its production C-123B's built with wing-tip J44 turbojets and wheel/ski landing gear. These aircraft are used in Arctic areas for logistic support of the DEW-line radar chain and for rescue duties.



The Fairchild C-123B Provider Military Transport (two 2,500 h.p. Pratt & Whitney R-2800 engines).



The Fairchild C-123B Provider Military Transport (two 2,500 h.p. Pratt & Whitney R-2800 engines).

TYPE.—Twin-engined Troop and Cargo-carrying Transport for operation from short or unprepared landing fields.

WINGS.—High-wing cantilever monoplane. Aspect ratio 9.89. All metal structure. Flaps inboard of ailerons and divided by tail cones of engine nacelles. Aileron area 83.28 sq. ft. (7.73 m.²), flap area 128.00 sq. ft. (11.89 m.²), gross wing area 1,223.22 sq. ft. (113.64 m.²).

FUSELAGE.—The main fuselage frame is of stressed-skin monocoque construction. The nose is of truss-type welded steel tubing to provide maximum crash protection for flight personnel.

TAIL UNIT.—Cantilever monoplane type. All-metal structure with fabric-covered control surfaces. Trim-tabs in elevators and rudder. Total horizontal tail area 345.5 sq. ft. (32.09 m.²), fin area 127.5 sq. ft. (11.84 m.²) plus dorsal fin 68.3 sq. ft. (6.34 m.²), elevator area 127.8 sq. ft. (11.85 m.²), rudder area 59.19 sq. ft. (5.59 m.²). Tailplane span 39 ft. 2 in. (11.94 m.).

LANDING GEAR.—Retractable tricycle type. Main gear retracts up into fuselage and is completely enclosed when retracted. A high-strength drag link is incorporated to carry drag loads and side loads from the gear to increase the utility of the aircraft for rough field operation. The dual wheel nose wheel unit is also completely retractable. Goodyear wheels of removable-flange type and Goodyear brakes with Westinghouse Decelostat anti-skid equipment. Wheelbase 23 ft. 11 in. (7.3 m.). Track 12 ft. 1 in. (3.69 m.).

POWER PLANT.—Two 2,500 h.p. Pratt & Whitney R-2800-99W radial air-cooled engines driving Hamilton Standard three-blade steel constant-speed feathering and reversing airscrews. Jettisonable self-sealing fuel tanks installed in nacelles. Total internal fuel capacity 1,462 U.S. gallons (5,520 litres). Provision for two auxiliary drop tanks, 450 U.S. gallons (1,700 litres) each. The power-plant installation is such that a complete engine change forward of the fire-wall, may be made in 45 minutes. Quick disconnect fittings are provided in all lines and mechanisms to facilitate the operation.

ACCOMMODATION.—Flight compartment in nose, seats crew of two. Cargo compartment 36 ft. 8 in. (11.18 m.) long, 9 ft. 2 in. (2.79 m.) wide and 8 ft. 2 in. (2.48 m.) high with a usable floor area of 450 sq. ft. (41.8 m.²) and cubic capacity of 3,570 cub. ft. (100 m.³). The compartment floor is stressed to support distributed loads of 250 lb./sq. ft. (1,220 kg./m.²) and two treadways accommodate vehicles with loadings up to 6,500 lb. (3,405 kg.) per wheel. Tie-down fittings are spaced over total floor area on a 20 in. (50.8 cm.) grid pattern, each fitting capable of sustaining a 10,000 lb. (4,535 kg.) load in any direction. The large rear loading door is formed by lowering the rear sloping wall of the hold to form a ramp and an upper door which folds inside fuselage to give adequate clearance for vehicles, bulky freight, etc. Ramp is hydraulically operated. Compartment can receive a 155 mm. howitzer and one truck or any comparable combination of wheeled units. As a personnel carrier, plane can accommodate 60 fully-equipped troops, 50 stretcher patients, plus 6 sitting patients and 6 medical attendants. Personnel can enter by side doors which may also be used for parachute jumping.

DIMENSIONS.—
Span 110 ft. (33.55 m.).
Length 76 ft. 3 in. (23.25 m.).
Height 34 ft. 1 in. (10.38 m.).

WEIGHTS AND LOADINGS.—
Weight empty 31,058 lb. (14,100 kg.).
Max. gross weight 60,000 lb. (27,240 kg.).
Wing loading 49.0 lb./sq. ft. (239.12 kg./m.²).
Power loading at max. A.U.W. 12.0 lb./h.p. (5.44 kg./h.p.).

PERFORMANCE.—
Max. speed 245 m.p.h. (392 km.h.).
Cruising speed (at 61% power) 190 m.p.h. (304 km.h.).
Stalling speed 75 m.p.h. (120 km.h.).
Rate of climb 1,150 ft./min. (350 m./min.).
Service ceiling 23,000 ft. (7,015 m.).
Range with max. cargo and optimum cruising speed at 5,000 ft. (1,525 m.) 1,470 miles (2,350 km.).

THE FAIRCHILD SURVEILLANCE DRONE.

The Fairchild Aircraft Division is developing a pilotless combat reconnaissance drone aircraft for the U.S. Army. An artist's impression released in December, 1957, shows it to have a torpedo-shape fuselage with mid-set delta wings and inset ailerons, swept fin and rudder, and what appears to be an under-fuselage intake for the engine mounted in its tail. No other details are yet available.



The Fairchild Pilotless Combat Surveillance Drone.

FLETCHER

FLETCHER AVIATION CORPORATION.

HEAD OFFICE AND WORKS: FLETCHER AIRPORT, ROSEMEAD, CALIFORNIA.

Chairman of the Board: Wendell S. Fletcher.
President: Maurice C. Fletcher.
Vice-President: Leland C. Launer.
Secretary: Herbert E. Fletcher.
Treasurer: Todd Derlachter.

The Fletcher Aviation Corpn. entered the aircraft manufacturing field in 1941. Its first post-war aircraft was the FL-23 military liaison monoplane, followed by the FD-25 lightweight ground support aircraft.

The latest product of the company is the FU-24 general utility monoplane, of which 100 are being assembled in New Zealand for agricultural top-dressing work.

The Fletcher Aviation Corporation is one of the foremost producers of jettisonable fuel tanks in America. Over 250,000 fuel and napalm tanks, ranging in size from 40 to 1,700 U.S. gallons (150-6,432 litres), have been produced and delivered to the U.S. Air Forces under prime contracts.

Fletcher is also designing and building in-flight refuelling equipment. The wing-mounted hose-reel units used on the Convair R3Y flying-boats were designed and built by Fletcher.

THE FLETCHER FU-24 "UTILITY."

The FU-24 was designed primarily for agricultural top-dressing work in New Zealand. The prototype flew in July,

1954, followed by the first production aircraft five months later.

TYPE.—General Utility monoplane developed primarily for agricultural uses.

WINGS.—Low-wing cantilever monoplane. NACA 4415 wing section. Aspect ratio 6. Chord 7 ft. (2.13 m.). Dihedral (outer wings) 8°. Incidence +2°. All-metal two-spar double-celled structure. All-metal slotted flaps. All-metal plain-hinge ailerons. Total flap area 34 sq. ft. (3.16 m.²). Total aileron area 20 sq. ft. (1.86 m.²). Gross wing area 294 sq. ft. (27.31 m.²).

FUSELAGE.—All-metal semi-monocoque structure.

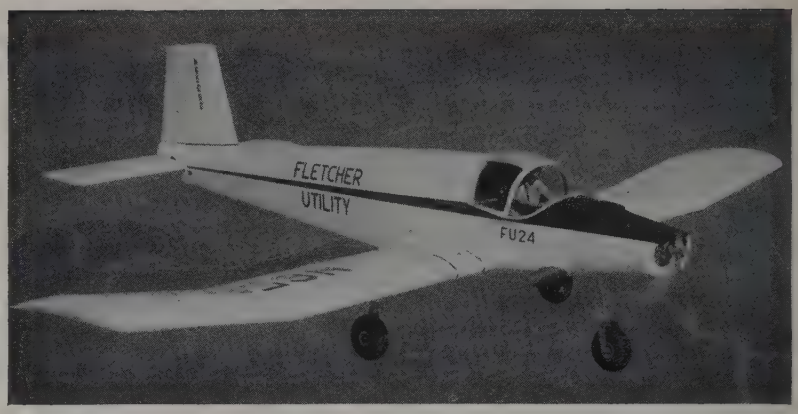
TAIL UNIT.—Cantilever all-metal structure. All-movable horizontal tail with anti-servo-tab. Areas: fin 13.6 sq. ft. (1.26 m.²), rudder 6.9 sq. ft. (0.64 m.²), tailplane 43.1 sq. ft. (4.00 m.²), servo tab 4.9 sq. ft. (0.45 m.²). Tailplane span 13 ft. 9⅛ in. (4.2 m.).

LANDING GEAR.—Fixed nose-wheel type. Fletcher air-oil shock-absorber struts. Goodrich wheels and tyres. Goodrich hydraulic expander tube brakes on main wheels. Track 12 ft. 2 in. (3.71 m.). Wheelbase 7 ft. 6 in. (2.28 m.).

POWER PLANT.—One 240 h.p. Continental O-470-N six-cylinder horizontally-opposed air-cooled engine. Hartzell or McCauley two-blade constant speed metal airscrew. Two fuel tanks (22 U.S. gallons each) one in each wing. Total fuel capacity 44 U.S. gallons (166 litres). Oil capacity 12 U.S. quarts (11.4 litres).

ACCOMMODATION.—Closed cockpit for pilot over leading-edge of wings. Compartment for four passengers or cargo, or two passengers and hopper, aft of cockpit.

DIMENSIONS.—
Span 42 ft. (12.81 m.).



The Fletcher FU-24 Utility (240 h.p. Continental O-470-N engine).

Length 31 ft. 10 in. (9.69 m.).
Height 9 ft. 4 in. (2.84 m.).

WEIGHTS AND LOADINGS (Normal).—
Weight empty 1,890 lb. (858 kg.).
Pilot 170 lb. (77 kg.).
Fuel 263 lb. (119 kg.).
Payload 1,077 lb. (489 kg.).
Weight loaded 3,500 lb. (1,588 kg.).
Wing loading 11.9 lb./sq. ft. (58.07 kg./m.²).
Power loading 14.6 lb./h.p. (6.62 kg./h.p.).

WEIGHTS (Agricultural).—
Weight empty 1,890 lb. (858 kg.).
Pilot 170 lb. (77 kg.).
Fuel 143 lb. (65 kg.).
Payload 1,607 lb. (730 kg.).
Weight loaded 3,910 lb. (1,775 kg.).

PERFORMANCE (Normal category, at 3,500 lb. = 1,588 kg. A.U.W.).—
Max. speed at S/L 138 m.p.h. (220.8 km.h.).
Cruising speed over 111 m.p.h. (179 km.h.).
Min. speed (flaps up, power off) 56 m.p.h. (89.6 km.h.).
Min. speed (flaps down, power off) 48 m.p.h. (77.2 km.h.).
Min. speed (flaps down, power on) 42 m.p.h. (67.2 km.h.).
Rate of climb at S/L 745 ft./min. (227 m./min.).
Service ceiling 14,780 ft. (4,410 m.).
Take-off to clear 50 ft. (15.25 m.), off grass 1,000 ft. (305 m.).

FORNEY

FORNEY MANUFACTURING COMPANY. Aviation Division.

HEAD OFFICE AND WORKS: FORT COLLINS, COLORADO.

In April, 1955 the Forney Manufacturing Company purchased the manufacturing rights for the Ercoupe light aeroplane, the original version of which was designed and marketed in 1940 by the Engineering and Research Corporation of Riverdale, Maryland.

In its original form, the Ercoupe incorporated a control system which eliminated the need for rudder pedals, the aeroplane being flown entirely by a control wheel. This version, known as the Ercoupe Model 415C went out of production when America entered the war, and when production was resumed post-war, the improved Ercoupe Model G Club-Air was offered with optional two-control or standard three-control system. Details of both versions have appeared in earlier editions of "All the World's Aircraft."

THE FORNEY F-1 AIRCOUPE.

The Forney Aircoupe is basically similar to the Ercoupe Model G Club-Air, which went out of production in 1951, but incorporates many detail improvements, in addition to a more powerful engine. The prototype F-1 Aircoupe made its first flight on February 18, 1956, and the first production model flew on September 20, 1956.

TYPE.—Two-seat Light monoplane.



The Forney F-1 Aircoupe (90 h.p. Continental C90 engine).

WINGS.—Cantilever low-wing monoplane. Wing section NACA 43013. Aspect ratio 6.31. Chord 5 ft. (1.52 m.). Dihedral 7°. Incidence 3½°. Aluminium structure. Aluminium ailerons with total area of 16.8 sq. ft. (1.56 m.²). No flaps. Gross wing area 142.6 sq. ft. (13.2 m.).

FUSELAGE.—All-metal monocoque structure.

TAIL UNIT.—Cantilever monoplane type, with twin fins and rudders. All metal structure with metal covering throughout. Areas: fins 1.35 sq. ft. (0.124 m.²), rudder 2.70 sq. ft. (0.25 m.²), elevators 9.4 sq. ft. (0.87 m.²), tailplane 8.2 sq. ft. (0.76 m.²). Tailplane span 8 ft. 6 in. (2.59 m.).

LANDING GEAR.—Fixed tricycle type, with Forney metal Belleville Spring shock struts. Goodyear 600 × 16 wheels and disc brakes. Wheel track 7 ft. 5 in. (2.26 m.). Wheelbase 5 ft. (1.52 m.).

POWER PLANT.—One 90 h.p. Continental C90-12F four-cylinder horizontally-opposed air-cooled engine driving a McCauley two-blade fixed-pitch metal airscrew. Fuel in two wing tanks each of 9 U.S. gallons (34 litres) capacity and one fuselage tank of 6 U.S. gallons (22.7 litres) capacity. Total fuel capacity 24 U.S. gallons (90.7 litres). Oil capacity 5 U.S. quarts (4.5 litres).

ACCOMMODATION.—Enclosed cabin seating two side-by-side with space behind for an extra seat suitable for a child weighing up to 75 lb. (34 kg.), or for 75 lb. (34 kg.) baggage.

DIMENSIONS.—
Span 30 ft. (9.14 m.).
Length 20 ft. 2 in. (6.15 m.).
Height (over tail) 6 ft. 3 in. (1.90 m.).

WEIGHTS.—
Weight empty 890 lb. (404 kg.).
Weight loaded 1,400 lb. (635 kg.).

PERFORMANCE.—
Max. cruising speed (75% power) 121 m.p.h. (194 km.h.).
Stalling speed 56 m.p.h. (90 km.h.).
Service ceiling 15,500 ft. (4,725 m.).
Absolute ceiling 18,000 ft. (5,485 m.).
Take-off distance 500 ft. (153 m.).
Landing distance 600 ft. (183 m.).
Range 500 miles (805 km.).

GAIL

GAIL AIRCRAFT ENGINEERING COMPANY.

HEAD OFFICE AND WORKS: MUNICIPAL AIRPORT, SACRAMENTO, CALIFORNIA.

This company has built the prototype of an agricultural aircraft known as the Gail Model 202 Mantis, which follows the lines of the pre-war Security Airster/Kinner Sportster series of braced low-wing monoplanes. It flew for the first time on May 30, 1956, and is described hereafter.

THE GAIL MODEL 202 MANTIS.

TYPE.—Single-seat Agricultural aircraft.

WINGS.—Braced low-wing monoplane. Clark Y wing section. Aspect ratio 6.6. Mean chord 6 ft. 0 in. (1.83 m.). Dihedral 4½°. Incidence 0°. Wood structure, fabric-covered. Multiple streamlined bracing struts. Wings fold back to lie alongside fuselage. Wooden ailerons with fabric covering. No flaps. Total area of ailerons 20.25 sq. ft. (1.88 m.²). Gross wing area 222 sq. ft. (20.6 m.²).

FUSELAGE.—Steel-tube structure with fabric covering.

TAIL UNIT.—Wire-braced monoplane type. Steel-tube structure with fabric covering. Areas: fin 7.2 sq. ft. (0.67 m.²), rudder 10.25 sq. ft. (0.95 m.²), tailplane 18.6 sq. ft. (1.73 m.²), elevators 13.9 sq. ft. (1.29 m.²). Tailplane span 12 ft. (3.66 m.).

LANDING GEAR.—Non-retractable tail-wheel type. Dual spring plunger shock-absorbers. Goodyear wheels and single disc brakes. Wheel track 9 ft. 2 in. (2.79 m.). Wheelbase 18 ft. (5.49 m.).

POWER PLANT.—One Lycoming O-435-1 six-cylinder horizontally-opposed air-cooled engine, rated at 190 h.p. at 2,550 r.p.m.

Two-blade Sensenich 85RB53 wooden fixed-pitch airscrew. One 25 U.S. gallon (94.5 litre) fuel tank in nose of fuselage. Oil capacity 3 U.S. gallons (11.4 litres).

ACCOMMODATION.—Single seat in open cockpit under tubular steel over-turn structure.

EQUIPMENT.—Agricultural dispenser suitable for liquid, dust and seed dispersal in fuselage.

DIMENSIONS.—
Span 40 ft. (12.19 m.).
Length 24 ft. 10 in. (7.57 m.).
Height 9 ft. 5 in. (2.87 m.).
Width folded 12 ft. (3.66 m.).

WEIGHTS AND LOADINGS.—
Useful load 1,315 lb. (596 kg.).
Max. payload 1,000 lb. (454 kg.).
Weight loaded 2,600 lb. (1,179 kg.).
Wing loading 11.7 lb./sq. ft. (57.2 kg./m.²).
Power loading 13.7 lb./h.p. (6.2 kg./h.p.).

PERFORMANCE.—
Max. speed 105 m.p.h. (169 km.h.).



The Gail Model 202 Mantis (190 h.p. Lycoming O-435 engine).

Normal cruising speed 90 m.p.h. (145 km.h.).
Economical cruising speed 80 m.p.h. (129 km.h.).
Landing speed 45 m.p.h. (72.5 km.h.).
Rate of climb at S/L. (max. payload) 600 ft./min. (185 m./min.).

GLUHAREFF

E. GLUHAREFF HELICOPTER CORPORATION.

HEAD OFFICE AND WORKS: PALM SPRINGS AIRPORT, PALM SPRINGS, CALIF.

President: Eugene M. Gluhareff.

Since 1954 this company has been engaged on development of pressure-jet engines for helicopter rotor tip-propulsion and a series of one-man helicopters powered by these engines. The helicopters have been undergoing tethered tests for more than two years and were expected to enter the free flight test phase during 1958.

The Gluhareff type of pressure-jet engine used in these aircraft is made of stainless steel and runs on propane fuel, which eliminates the fire hazards inherent with more usual fuels and produces a smokeless exhaust. The engines feature push-button starting, without auxiliary equipment, are capable of re-starting in the air and have 100% power throttling from idling to maximum. Each weighs 5½ lb. (2.5 kg.) and develops 18 lb. (8.17 kg.) s.t., equivalent to 14 h.p. Each of the experimental helicopters carries 12 lb. (5.44 kg.) of propane, sufficient for 12 minutes operation.

Larger versions of the pressure-jet engine are being developed for larger aircraft, and the E. Gluhareff Corporation intends to remain primarily a research and development organisation. Production of the developed aircraft is expected to be undertaken by McCulloch Motors Corporation of Los Angeles, who hold the exclusive licence for their manufacture.

THE GLUHAREFF MEG-1x.

The MEG-1x is a strap-on type one-man helicopter comprising a central pylon carrying at the bottom cylinders of propane fuel and compressed air, and at the top a single-bladed rotor with counterweight. A fixed tail surface is fitted and the helicopter is powered by a tip-mounted Gluhareff 8-8 pressure-jet engine giving a rotor r.p.m. of 320-370 in flight. Empty weight is 60 lb. (27.2 kg.) and loaded weight 260 lb. (118 kg.). The MEG-1x, which is undergoing tethered tests in prototype form, is expected to have a maximum speed of 55 m.p.h. (88.5 km.h.) and hovering ceiling of 4,500 ft. (1,370 m.).

THE GLUHAREFF MEG-2x.

The MEG-2x is basically similar to the MEG-1x, but has a two-bladed rotor with a diameter of 20 ft. (6.10 m.). Two Gluhareff 8-8 tip-mounted pressure-jets turn the rotor at 210-280 r.p.m. in flight. Weight empty is 68 lb. (30.8 kg.) and loaded 270 lb. (122.5 kg.). Estimated performance is similar to that of the MEG-1x.

A prototype of the MEG-2x was scheduled to begin free flight tests in 1958, after two years of tethered testing.

THE GLUHAREFF MEG-3x.

Utilising the same basic rotor and propulsion system as the MEG-2x, this aircraft is a "flying platform" in which the pilot stands above the rotor. It has a conventional tubular skid landing gear. Weight empty is 135 lb. (61 kg.) and loaded 400 lb. (181 kg.).

The prototype MEG-3x was scheduled to start its flight tests before the middle of 1958.

GOODYEAR

THE GOODYEAR AIRCRAFT CORPORATION.

HEAD OFFICE AND WORKS: AKRON 15, OHIO.

The Goodyear Aircraft Corporation, known primarily as a builder of airships, although the company did manufacture complete aircraft during the last war and is still engaged in important sub-contract work for other aircraft manufacturers, has now entered the light helicopter field.

The first Goodyear helicopter, the "Project 400" or Model GA-400R, was designed by the Goodyear Aircraft Corporation, built by the Goodyear Tire and Rubber Company subsidiary and was flown for the first time at the company's airport at Wingfoot Lake, Akron, Ohio, on May 9, 1954.

The company has, more recently, used its experience of airship design and manufacture to produce inflatable fabric rotor blades for helicopters and a lightplane with inflatable fuselage and wing. Details of this aircraft are given hereafter.

THE GOODYEAR INFLATOPLANE.

The Goodyear Inflatoplane is a light aircraft with a completely pneumatic airframe. Cockpit, wing and tail assembly are made of Airmat, which consists of two walls of rubberised fabric connected by nylon threads. The fuselage is of simple rubberised fabric. The entire aircraft can be carried in the rear of an estate wagon and inflated with a domestic vacuum cleaner.

The Inflatoplane has a horizontally-opposed air-cooled two-stroke engine, mounted above the rear of the wing and driving a two-blade wooden tractor airscrew. Flying controls are conventional and the rigidity of the wing is such that it will support the weight of a man on each side immediately outboard of the bracing struts.

Since the original prototype flew in 1956, several improved versions have been developed under military contracts, with both open and enclosed cockpits and alternative wheel and single hydro-ski landing gear. On these models, a compressor can be fitted at the back of the engine to maintain pressure in the airframe even when a number of .30 in. calibre bullets have pierced the fabric.

Two versions of the Inflatoplane are:—

XAO2G-1 (Model GA-466). Two-seater with 65 h.p. McCulloch 4318E engine.

XAO3G-1 (Model GA-468). Single-seater, with 44 h.p. Nelson engine. Five built for U.S. Navy, five for U.S. Army.

DIMENSIONS (XAO2G-1).—
Span 28 ft. (8.5 m.).
Length 19 ft. 2 in. (5.8 m.).

DIMENSIONS (XAO3G-1).—
Span 22 ft. (6.7 m.).
Length 19 ft. 8 in. (6.0 m.).

WEIGHTS (XAO2G-1).—
Weight empty 290 lb. (130 kg.).
Weight loaded 810 lb. (370 kg.).

PERFORMANCE (XAO2G-1).—
Max. speed 80.5 m.p.h. (129 km.h.).
Cruising speed 69 m.p.h. (110 km.h.).
Endurance 3 hours.

THE GOODYEAR GA-400R-3 GIZMO.

The GA-400R-3, a one-man ultra-light helicopter, was designed to serve either as a courier-liaison or tactical vehicle. It has no military designation but has been demonstrated for various U.S. military agencies.

The airframe of welded aluminium tubing is supported by steel outrigger tubes and parallel aluminium tubular skids. Power is supplied by a Johnson 35 two-stroke engine which develops 38



The Goodyear Inflatoplane (44 h.p. Nelson H-59A engine).

h.p. at 5,000 r.p.m. and drives the main and anti-torque rotors through a belt and pulley arrangement. Fuel capacity is 4 U.S. gallons (15.2 litres).

The GA-400R-3 helicopter is still in the experimental stage and at the time of writing no structural details had been disclosed.

DIMENSIONS.—
Diameter of main rotor 20 ft. (6.10 m.).
Length 21 ft. (6.40 m.).
Height to top of rotor pylon 7 ft. 0½ in. (2.14 m.).

WEIGHTS.—
Normal loaded weight 490 lb. (222.5 kg).
Max. loaded weight 520 lb. (236 kg.).

PERFORMANCE.—
Max. speed 65 m.p.h. (104 km.h.).
Cruising speed 50 m.p.h. (80 km.h.).
Rate of climb 500 ft./min. (150 m./min.).
Hovering ceiling 6,000 ft. (1,830 m.).
Service ceiling (estimated) 12,000 ft. (3,660 m.).
Range with max. payload 50 miles (80 km.).

GRUMMAN



The Grumman Gulfstream Executive Transport (two Rolls-Royce Dart 529 turboprop engines).

GRUMMAN AIRCRAFT ENGINEERING CORPORATION.

HEAD OFFICE AND WORKS: BETHPAGE, LONG ISLAND, N.Y.

Incorporated: December 6, 1929.

Chairman of the Board: Leroy R. Grumman.

President: Leon A. Swirbul.

Senior Vice-President: William T. Schwendler.

Administrative Vice-President: E. Clinton Towl.

Vice-President: Robert L. Hall.

Vice-President, Manufacturing Engineering: William J. Hoffman.

Vice-President, Production: David Rittenhouse.

Vice-President, Contracts: George F. Titterton.

Vice-President and General Counsel: Charles Kingsley.

Secretary: Joseph A. Stamm.

Treasurer: Edmund W. Poor.

The Grumman Aircraft Engineering Corpn. continues to devote its principal activities to the construction and experimental development of aircraft for the U.S. Navy, although it is also developing a turboprop-powered executive transport named the Gulfstream and has built the prototype of a single-seat single-engined biplane for agricultural use.

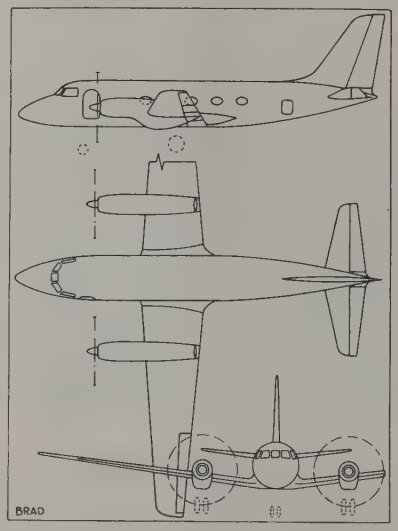
Grumman is currently producing for the U.S. Navy the supersonic F11F-1 Tiger light carrier-based fighter; the F9F-8T Cougar jet fighter-trainer; the S2F Tracker anti-submarine aircraft and its developments, the TF-1 Trader, a carrier-based logistics transport, and the WF-2 Tracer early-warning aircraft. Under development are the A2F carrier-based jet-powered attack aircraft for the U.S. Navy and the AO-1 Mohawk observation aircraft for the U.S. Army.

The Albatross amphibian flying-boat is still being built for the U.S. and Indonesian Air Forces.

THE GRUMMAN G-159 GULFSTREAM.

Grumman have built two prototypes of a 10/12-passenger pressurised light executive transport named the Gulfstream. The first of these flew for the first time on August 14, 1958, by which time the company had received orders for 27 Gulfstreams. Deliveries are to begin in 1959.

TYPE.—Twin-turboprop Executive Transport.



The Grumman G-159 Gulfstream

WINGS.—Low-wing cantilever monoplane. Single box beam structure with integrally-stiffened machined upper and lower skins. Integral fuel tanks outboard of fuselage.

FUSELAGE.—All-metal pressurised structure.

TAIL UNIT.—Cantilever monoplane type. All-metal structure.

LANDING GEAR.—Retractable nose-wheel type. Twin main wheel units retract forward of main wing beams to avoid cut-outs in primary wing structure. Nose-wheel retracts forward into compartment below flight deck. Main landing-gear used as speed brake.

POWER PLANT.—Two 2,105 e.s.h.p. Rolls-Royce Dart 529 (RDa. 7/2) turboprop engines, with provision for Darts of higher power when they become available. Four-blade Rotol constant-speed airscrews. Integral fuel tanks in wing box beams. Normal fuel capacity 1,304 U.S. gallons (4,940 litres). Maximum internal fuel 1,480 gallons (5,594 litres).

ACCOMMODATION.—Pressurised accommodation for crew of two and 10-12 passengers in executive version. A 19-passenger high-density interior will also be available. Passenger cabin is 32 ft. 8 in. (10.0 m.) long and 6 ft. 1 in. (1.85 m.) high. Cabin pressurised to maintain 5,500 ft. (1,680 m.) cabin altitude at 25,000 ft. (7,625 m.). Pressurised baggage compartment of 100 cub. ft. (2.83 m.³) in addition to 28 cub. ft. (0.79 m.³) of luggage space in the forward cabin. Toilet compartment with hot and cold water. Hydraulically-operated self-contained stairway forward of cabin. Interior furnishings and equipment of executive versions left to individual choice.

EQUIPMENT.—Radio and navigation equipment includes weather radar, auto pilot and integrated flight systems. Auxiliary power unit for ground operation of cabin air conditioning equipment, radio, lights, etc. independent of main engines.

DIMENSIONS.—
Span 78 ft. 6 in. (23.9 m.).
Length 64 ft. (19.5 m.).
Max. height 22 ft. 9 in. (6.94 m.).

WEIGHTS (designed).—
Weight empty equipped 19,029 lb. (8,639 kg.).
Crew, plus baggage 420 lb. (190 kg.).
Fuel (1,304 U.S. gal. = 4,940 litres) 8,800 lb. (4,000 kg.).
Oil 56 lb. (25.4 kg.).
Water methanol fluid 100 lb. (45.4 kg.).
Passengers (12) plus baggage at 40 lb. (18 kg). per passenger 2,520 lb. (1,144 kg.).
Take-off weight 31,000 lb. (14,074 kg.).
Design landing weight 30,000 lb. (13,620 kg.).

PERFORMANCE (estimated).—
Max. cruising speed 370 m.p.h. (592 km.h.) at 25,000 ft. (7,625 m.).
Recommended cruising speed at 25,000 ft. (7,625 m.) 345 m.p.h. (555 km.h.).
Rate of climb at S/L 2,300 ft./min. (700 m./min.).
Single-engine rate of climb at S/L 700 ft./min. (213 m./min.).
Service ceiling 36,000 ft. (10,980 m.).
Single-engine service ceiling 17,000 ft. (5,185 m.).
C.A.A. field length at S/L at max. A.U.W. 3,970 ft. (1,210 m.).
C.A.A. field length at S/L at 26,000 lb. (11,795 kg.) A.U.W. 3,000 ft. (915 m.).
C.A.A. field length at 5,000 ft. (1,525 m). altitude at max. A.U.W. 5,000 ft. (1,525 m.).
Max. stage length, including 230 mile (370 km.) diversion and 30 min. holding at 25,000 ft. (7,620 m.) 2,200 miles (3,540 km.).
Range with max. payload and reserves as above 1,840 miles (2,960 km.).
T.O. run at S/L with water-methanol at 31,000 lb. = 14,074 kg. A.U.W., standard day (59°F.) 2,115 ft. (645 m.), hot day (113°F.) 2,390 ft. (730 m.).
Landing run at S/L 1,355 ft. (407 m.).

THE GRUMMAN A2F.

A2F is the designation given to the design submitted by Grumman which was successful in the U.S. Navy's 1957 attack aircraft competition. Designed for high and low altitude operation, the carrier-based A2F will be powered by



The Grumman Ag-Cat Agricultural Biplane (220 h.p. Continental W-670 engine).

two Pratt & Whitney J52 turbojets and will carry a crew of two. Further details of this aircraft remain classified. The prototype is expected to fly by mid-1959.

THE GRUMMAN G-164 Ag-CAT.

TYPE.—Single-seat Agricultural biplane.

WINGS.—Single-bay staggered biplane. NACA 4412 (modified) high-lift wing section. Aspect ratio 7.81 (upper wing), 5.29 (biplane-estimated mean). Dihedral 3°. Incidence 6°. Duralumin two-spar wing structure with duralumn covering. N-type interplane struts. Duralumin-framed fabric-covered ailerons on all four wings. No flaps. Total aileron area 31.5 sq. ft. (2.93 m.²). Gross wing area 326 sq. ft. (30.28 m.²).

FUSELAGE.—Steel tube framework covered with duralumin sheet.

TAIL UNIT.—Braced monoplane type. Steel tube frames, fabric covering. Areas: fin 9 sq. ft. (0.836 m.²), rudder 12 sq. ft. (1.115 m.²), tailplane 22.8 sq. ft. (2.118 m.²), elevators (total) 22.2 sq. ft. (2.062 m.²). Tailplane span 13 ft. (3.96 m.).

LANDING GEAR.—Fixed tail-wheel type. Cantilever Cessna-type spring-steel legs. 8.50 × 6.00 wheels and low-pressure tyres. Disc brakes. Spring tail-wheel. Wheelbase 18 ft. 6 in. (5.64 m.). Track 7 ft. 10 in. (2.38 m.).

POWER PLANT.—One 220 h.p. Continental W-670-11 nine-cylinder radial air-cooled engine. McCauley steel-blade airscrew. Fuel tank (34 U.S. gallons—128.5 litres) in upper centre section.

ACCOMMODATION.—Single open cockpit aft of wings. Re-inforced fairing aft of cockpit for "turn-over" protection. Forward of cockpit over C.G. is container for agricultural chemicals (dry or liquid) with distributor beneath fuselage. Designed to carry 1,000 lb. (454 kg.) chemicals (to requirements of GAM.8).

DIMENSIONS.—
Span 35 ft. 8 in. (10.87 m.).
Length 24 ft. 4 in. (7.42 m.).
Height 10 ft. 9 in. (3.27 m.).

WEIGHTS.—
Weight empty 2,179 lb. (989 kg.).
Weight loaded 3,600 lb. (1,634 kg.).

PERFORMANCE.—
No data available.

THE GRUMMAN MOHAWK.
U.S. Army designation: AO-1.

Grumman are developing a high-performance observation aircraft for the U.S. Army, the prototype of which is scheduled to fly in 1959. It will be a mid-wing monoplane of conventional configuration, with tricycle landing gear and powered by two Lycoming T53 turboprop engines, driving large-diameter airscrews.

Carrying a crew of two side-by-side, in ejection seats, the Mohawk is intended to combine a top speed of 350 m.p.h. (560 km.h.) with the ability to operate from short unimproved airfields.

DIMENSIONS.—
Span 42 ft. (12.80 m.).
Length 42 ft. 9½ in. (13.04 m.).

THE GRUMMAN G-98 TIGER.
U.S. Navy designation: F11F.

The Tiger is a single-seat supersonic fighter which is in production for and in service with the U.S. Navy.

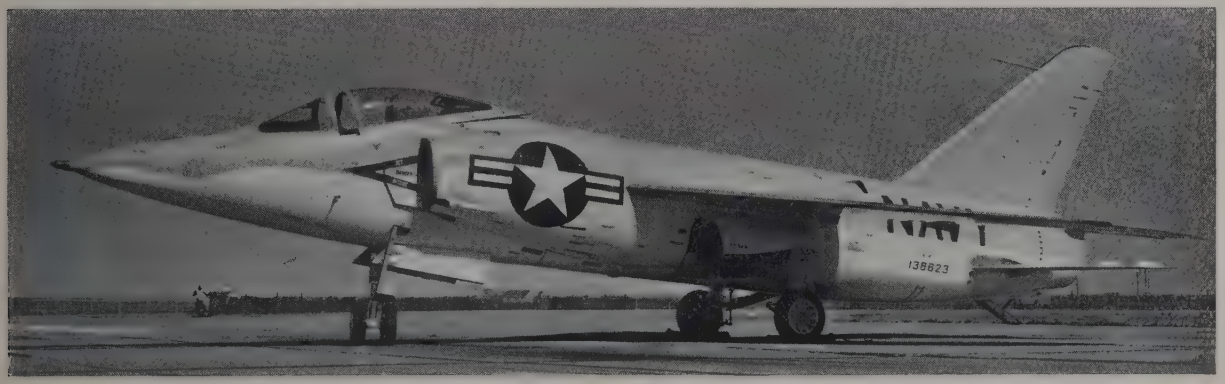
Three versions of the Tiger have been announced :—

F11F-1. Initial production version. Prototype flew on July 30, 1954, less than 15 months after receipt of Letter of Intent from Navy Bureau of Aeronautics. Six pre-production aircraft with Wright J65-W-6 turbojet and afterburner. Thirty-nine production aircraft ordered with J65-W-4 and afterburner, two of which have been modified to F11F-1F standard.

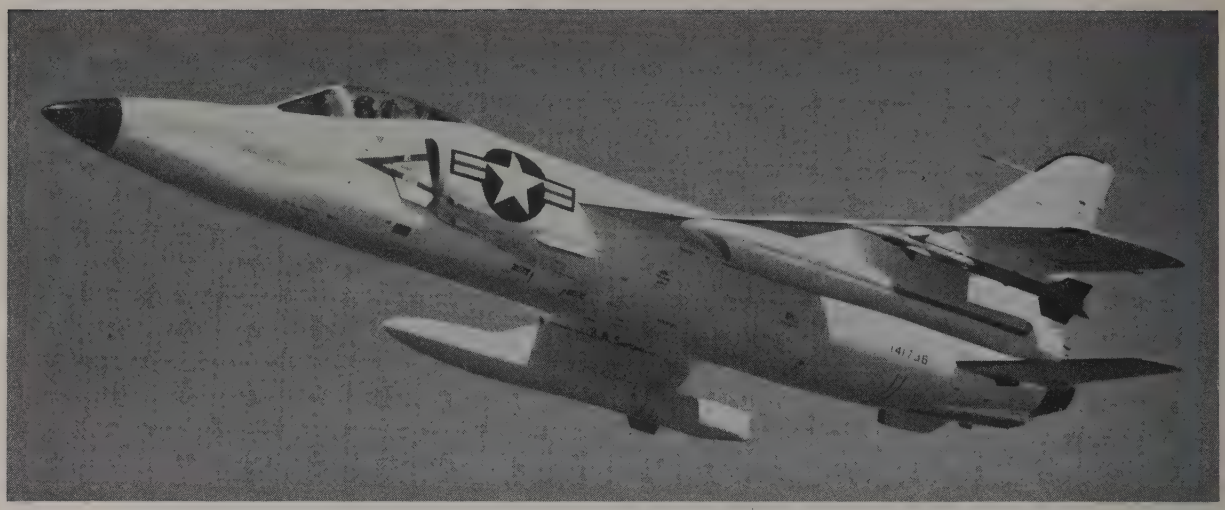
F11F-1F. Two F11F-1 aircraft modified with General Electric J79-GE-7 turbojet and afterburner (15,000 lb.=



A mock-up of the Grumman AO-1 Mohawk (two Lycoming T53 turboprop engines).



The Grumman F11F-1 Tiger Naval Carrier Fighter (Wright J65 turbojet engine with afterburner). (*Gordon Williams*).



The Grumman F11F-1 Tiger Naval Carrier Fighter (Wright J65 turbojet engine with afterburner).

6,805 kg. s.t.) instead of J65. Enlarged air intakes and rear fuselage. Sweep-forward on inboard portions of wing leading edges. Has been selected by the Japanese Defense Agency for use by the Japanese Air Self-Defense Force. Production will start in 1959 and 300 aircraft will be built before the end of 1962. The majority will be produced by Mitsubishi.

One of the prototype F11F-1F's has attained a speed of more than 1,220 m.p.h. (1,963 km.h.) and set up a short-lived aeroplane height record of 76,932 ft. (23,449 m.) on April 18, 1958.

F11F-1FT. Two-seat trainer version of F11F-1F. Fuselage lengthened by 12 in. (0.30 m.). A.U.W. reduced by 500 lb. (227 kg.).

The following details apply to the standard F11F-1 Tiger :—

TYPE.—Single-seat Naval Carrier Fighter.

WINGS.—Cantilever mid-wing monoplane. 30° leading-edge sweepback. 6.5% thickness/chord ratio. All-metal structure. One-piece machined upper and lower skins. Leading-edge slats. Trailing-edge flaps over whole of fixed portion of wings, the wing-tips being manually hinged for carrier stowage. Lateral control by spoilers. Small trim-tab outboard of port flap.

FUSELAGE.—All-metal structure. Finger-type air brakes on underside of fuselage in line with trailing-edge of wings.

TAIL UNIT.—All surfaces swept. Comprises fixed fin, rudder and low-mounted all-flying tailplane with slight dihedral.

LANDING GEAR.—Retractable tricycle type. All wheels retract into fuselage.

POWER PLANT.—One Wright J65-W-6 axial-flow turbojet engine (7,800 lb.=3,540 kg. s.t.) with afterburner. Fuel in integral wing tanks. Provision for flight refuelling with retractable probe on starboard side of forward fuselage. External fuel tank can be carried under each wing.

ACCOMMODATION. — Pressurised cockpit in nose. Ejector seat.

ARMAMENT.—Four 20 mm. cannon. Provision for air-to-air (Sidewinder) and air-to-ground missiles.

DIMENSIONS.—
Span 31 ft. 7½ in. (9.65 m.).
Length 40 ft. 10 in. (12.44 m.).
Height 12 ft. 9 in. (3.88 m.).

WEIGHTS.—
Normal loaded weight 13,850 lb. (6,290kg.).

PERFORMANCE.—No data available.

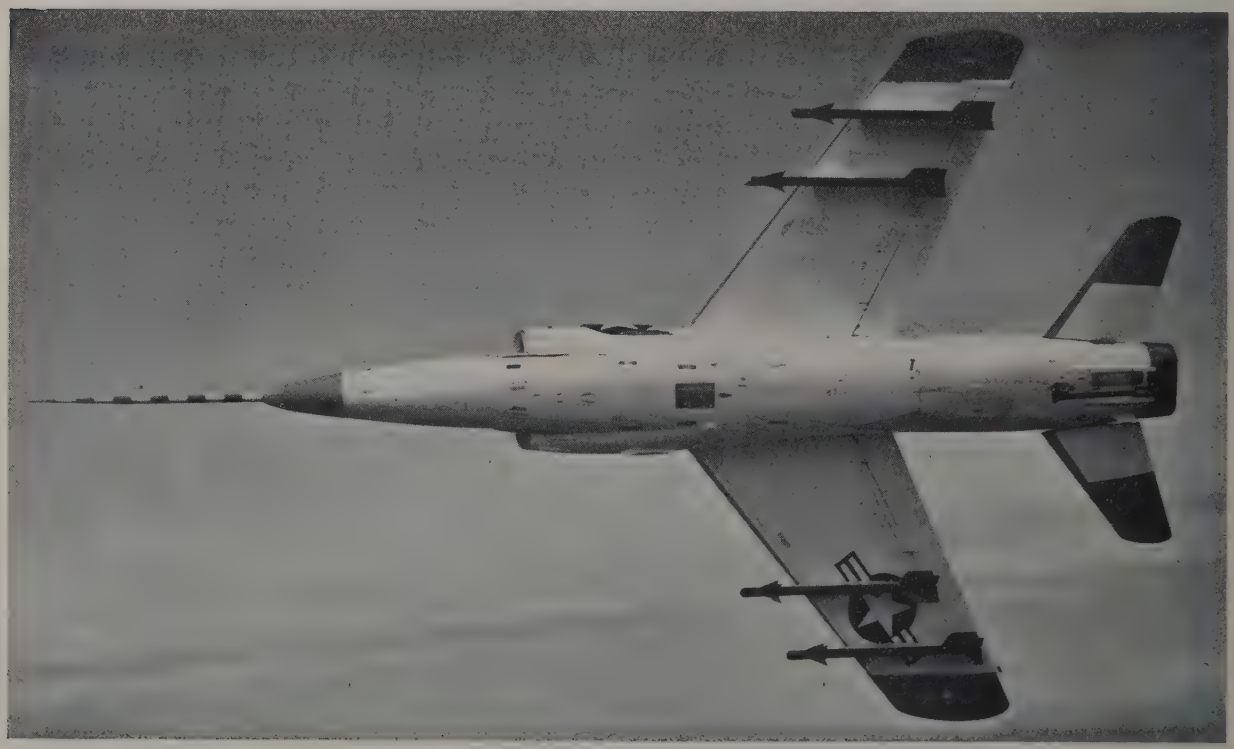
THE GRUMMAN G-93 COUGAR.
U.S. Navy designation: F9F.

The only version of the Cougar still in production in 1958 was the F9F-8T two-seat jet fighter-trainer, although the F9F-8 combat version is still in service in the U.S. Navy and Marine Corps. The earlier F9F-6 and F9F-7 were withdrawn from production in 1954.

The following are the current service versions of the Cougar :—

F9F-8. One Pratt & Whitney J48-P-8 engine. Single-seat carrier-based fighter. Development of F9F-6 with greater speed and range. Movable leading-edge slats replaced by fixed cambered leading-edge extensions outboard of fences and trailing-edge extended. Total internal fuel capacity increased by 140 U.S. gallons. Standard armament of four 20 mm. cannon with provision for various combinations of under-wing stores and/or auxiliary fuel tanks. First production F9F-8 flew for first time on January 18, 1954. F9F-8P (first flown August 21, 1955) is photographic reconnaissance version with extended nose for cameras. Out of production in 1957.

F9F-8T. Two-seat fighter-trainer version of F9F-8, first flown on April 4, 1956. Nose section lengthened 34 in. (86 cm.) to



The Grumman F11F-1 Tiger Naval Carrier Fighter armed with four Sidewinder air-to-air missiles.



The Grumman F9F-8T Cougar Two-seat Fighter Trainer (Pratt & Whitney J48 turbojet engine).

accommodate second cockpit. Both cockpits have Martin-Baker ejector seats and standard F9F-8 controls, instruments, etc. and can be used interchangeably by instructor and pilot. When flown as single-seater forward cockpit is used. Armament consists of two 20 mm. cannon and wide variety of air-to-air or air-to-ground stores can be carried under wings. In addition to training, F9F-8T can be used as an operational fighter. First deliveries made in mid-1956, and still in production.

The following description applies to the F9F-8T.

TYPE.—Two-seat Jet Fighter Trainer.

WINGS.—Low-wing cantilever swept-wing monoplane. Outboard of air inlets wings have 35° L/E. sweepback. All-metal structure with flush-riveted stressed skin. Trailing-edge flap over ¾ span. Lateral control by hydraulically-operated spanwise spoilers on upper surface of wings at 75% of chord line. Artificial feel system incorporated in lateral control. Electrically operated trim-tab near port wing-tip.

FUSELAGE.—All-metal structure with flush-riveted stressed skin. Quickly-detachable nose for servicing equipment and interchangeability of armament, photographic and electronic equipment. Tail section detachable for access to engine compartment.

TAIL UNIT.—Cantilever monoplane type. All-metal structure. Hydraulically adjustable tailplane linked with flap control to provide constant longitudinal trim during flap movement. Electrically-operated trim-tab in rudder.

LANDING GEAR.—Retractable nose-wheel type. Main wheels raised inwardly into thickened wing roots, nose-wheel backwards into fuselage. Hydraulic actuation. Retractable arrester hook in rear end of fuselage below jet pipe.

POWER PLANT.—One Pratt & Whitney J48 turbojet engine. Self-sealing fuel tanks in fuselage and non-sealing bladder tanks in wings. Provision for flight refuelling with fixed nose-probe. All tanks pressurised and all fuel can be jettisoned from wing-tip outlets by ram pressure. Provision for two 150 U.S. gallon drop tanks to be carried on under-wing bomb shackles.

ACCOMMODATION (F9F-8T).—Tandem cockpits under continuous sliding and jettisonable canopy. Dual controls. Martin Baker ejection seats.

ARMAMENT (F9F-8T).—Two nose-mounted 20 mm. cannon. Under-wing racks for either two 1,000 lb. bombs or six HVAR rockets or four Sidewinder air-to-air missiles.

DIMENSIONS.—
Span 34 ft. 6 in. (10.52 m.).
Length (F9F-8) 41 ft. 7 in. (12.68 m.).
Length (F9F-8T) 44 ft. 5 in. (13.54 m.).
Height 12 ft. 3 in. (3.73 m.).

WEIGHTS.—
Normal loaded weight about 20,000 lb. (9,080 kg.).

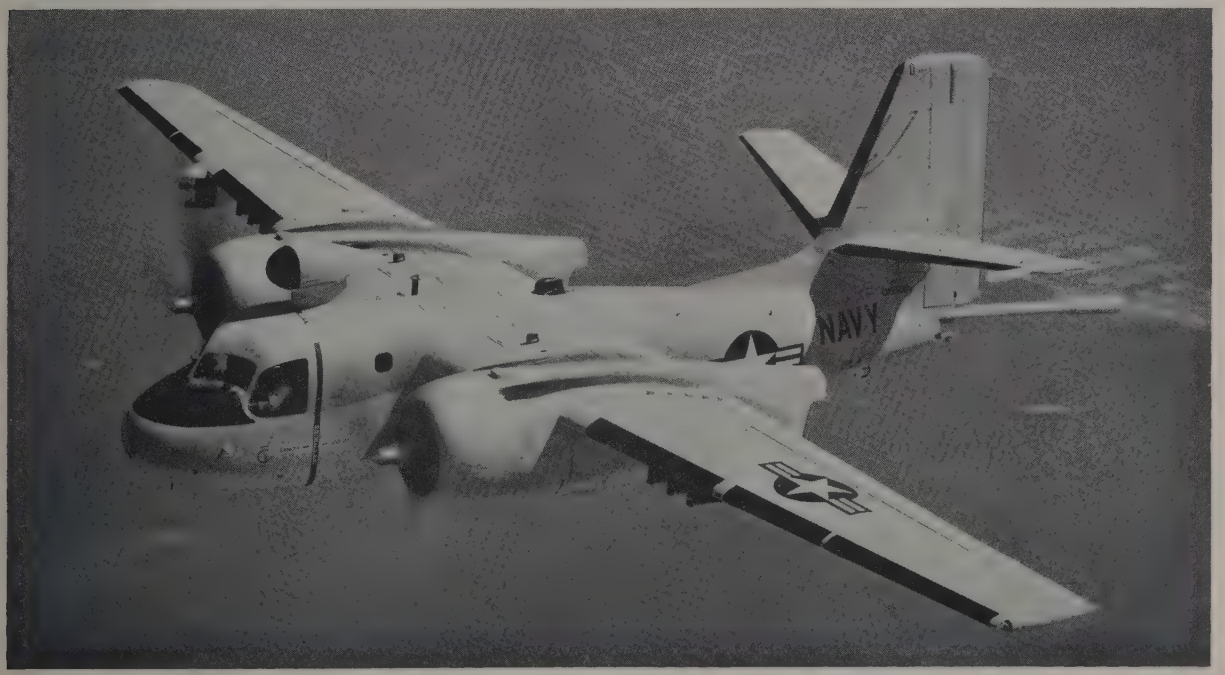
PERFORMANCE.—Restricted.

THE GRUMMAN G-89 TRACKER.
U.S. Navy designation: S2F.

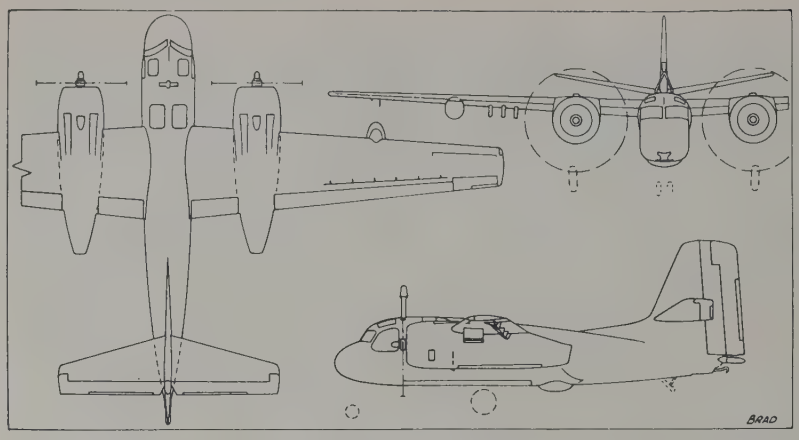
The S2F is a twin-engined carrier-based Anti-Submarine search and attack aircraft which is in production and in service with the U.S. Navy. Six have also been delivered to the Italian Navy and 30 have been supplied to the Japanese Maritime Self-Defence Force. The prototype XS2F-1 made its first flight on December 4, 1952.

The S2F is a high-wing monoplane which is powered by two Wright R-1820 engines. The tricycle landing-gear has a dual-wheel nose-wheel unit and there is a small wheel-bumper aft which is extendable but not fully retractable. A split rudder has been developed for the S2F to assist single-engine performance.

There is a retractable radome under the rear fuselage behind a large bomb-bay, and a retractable MAD gear in the tail. The U.S. Navy's "Betty" atomic depth charge can be carried in the bomb-bay, Sonobuoys in special housings in the rear ends of the engine nacelles and rocket armament under wings.



The Grumman S2F-1 Tracker (two 1,525 h.p. Wright S-1820 engines).



The Grumman S2F-1 Tracker.

A crew of four consists of pilot, co-pilot (who serves as navigator, radio-operator and searchlight-operator), radar operator and MAD operator.

The following versions of the S2F have been mentioned :—

S2F-1. Two 1,525 h.p. Wright R-1820-82 engines. First production model.

S2F-2. Developed version of S2F-1 to carry new and larger anti-submarine weapons. An enlarged torpedo bay with asymmetrical extension on port side of fuselage accommodates homing torpedoes.

To compensate for increased weight the tail surfaces have been increased in area.

S2F-3. New version ordered by U.S. Navy in 1958. No details available.

CS2F-1. Canadian production version of S2F-1 being built under licence for Royal Canadian Navy by de Havilland Aircraft of Canada, Ltd. Powered by two 1,525 h.p. Wright R-1820-82 engines and Hamilton Standard airscrews built by Canadian Pratt & Whitney Aircraft Co., Ltd.

No other details of this aircraft had been released for publication up to the time of going to press.

DIMENSIONS.—
Span 69 ft. 8 in. (21.24 m.).
Length 42 ft. 3 in. (12.88 m.).
Height 16 ft. 3½ in. (4.96 m.).
Span of tail 22 ft. 5 in. (6.84 m.).

THE GRUMMAN TRADER.
U.S. Navy designation: TF.

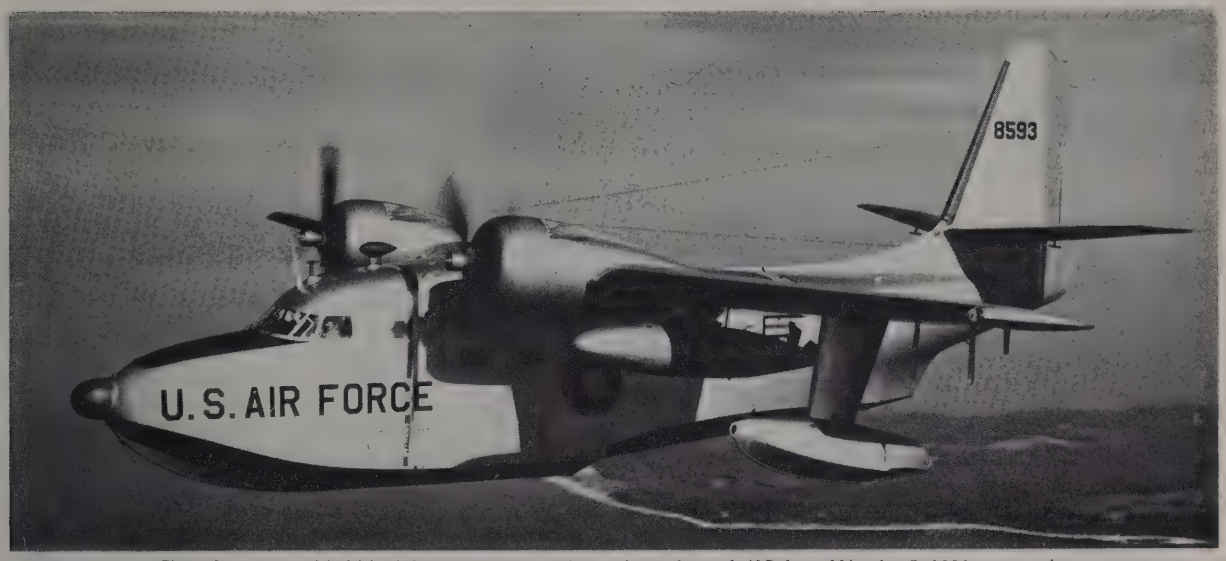
The TF-1 Trader is a general utility-transport-trainer version of the S2F Tracker. Its larger fuselage can accommodate up to nine passengers in backward-facing easily-removable seats. To secure cargo in arrested carrier landings a "cage" device, comprising two parallel sets of movable vertical bulkheads secured between upper and lower longitudinal rails, is used. Vertical side posts may be fitted at any point along the length of the "cage" depending on size of load. Secured cargo will withstand maximum force of 20G. Life-rafts are stowed in compartments in the rear ends of the engine nacelles. Except for the fuselage, the main components of the TF-1 are interchangeable with those of the S2F, including power-plant assemblies, outer wings, landing-gear, the larger S2F-2 tail-unit, etc. Equipped with the latest



The Grumman TF-1 Trader General Utility Transport-Trainer.



The Grumman WF-2 Tracer, the Airborne Early-Warning and Fighter Direction version of the S2F.



The Grumman SA-16A Albatross Rescue Amphibian (two 1,425 h.p. Wright R-1820 engines).

navigational devices the TF-1 is also suitable for all-weather operational carrier-training. The first TF-1 flew for the first time in January, 1955.

THE GRUMMAN TRACER.
U.S. Navy designation: WF-2.

The WF-2 Tracer is a modification of the TF-1 Trader for airborne early warning and fighter direction duties. Suitable for all weather operation, it is equipped with a long-range antenna housed in the largest radome yet designed for a carrier-based aircraft. The aerodynamic prototype flew on March 1, 1957.

The WF-2 has a completely new tail assembly with twin fins and rudders to reduce possible wake effects from the radome, which is mounted above the fuselage. Production WF-2's also have a re-designed wing folding system, in which the wings fold back to lie alongside the fuselage, instead of upwards as on the TF-1.

A crew of four is carried, with two pilots in the cockpit and two warning system operators in a crew compartment. For airborne early warning operations and training, one pilot moves to the tactical director's position, on a stowable seat located between the operators. This seat is not occupied during take-off and landing.

Production WF-2 Tracers are equipped with an early warning system produced by the Hazeltine Electronics Corporation of Little Neck, New York, which has worked with Grumman in the design and development of the system. The skin of the radar housing is of Fiberglas honeycomb sandwich material.

The WF-2 is suitable for operation from all U.S. Navy attack carriers.

THE GRUMMAN G-64 ALBATROSS.
U.S. Air Force designation : SA-16A.
U.S. Navy and Coast Guard designation: UF-1.

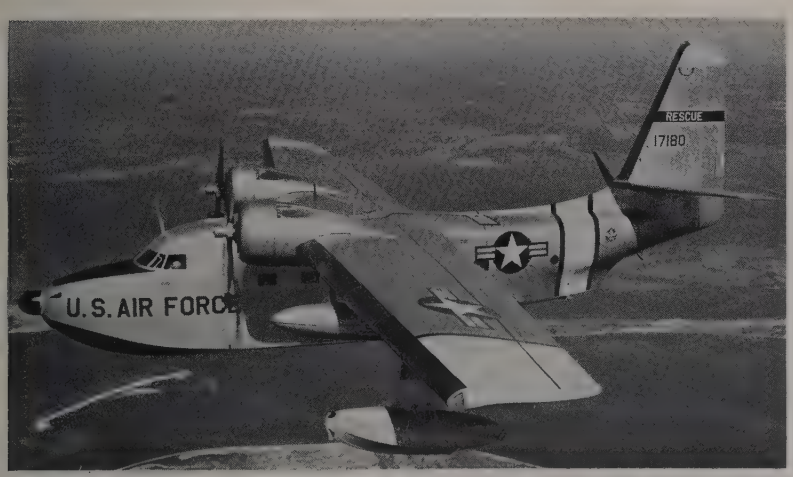
The following versions of the Albatross are in service :—

SA-16A. Basic amphibian design in service with the U.S.A.F. for Sea Rescue duties. 305 built. A few fitted with tri-phibious sprung skis to make possible operation from ice and snow as well as land and water. Will be converted to SA-16B standard as they come in to Grumman for inspection and repair.

SA-16B. Improved version of SA-16A, with higher speed, increased range and improved single-engine performance. Wing span increased by 16 ft. 6 in. (5.03 m.). Larger tail surfaces. Wing slots replaced by cambered leading edges. Antenna housings modified to reduce drag. New high-pressure de-icing boots on wing and tail. Prototype first flown January 16, 1956. Delivery of SA-16A aircraft modified to SA-16B standard began in February, 1957.

UF-1. General utility amphibian for U.S. Navy and Coast Guard, similar to SA-16A. Will be modified to SA-16B standard as received for inspection and repair. Also ordered by Republic of Indonesia and the Federal Republic of Germany.

The following details apply specifically to the SA-16A and UF-1 versions of the Albatross.



The Grumman SA-16B Albatross Amphibian (two 1,425 h.p. Wright R-1820 engines).

TYPE.—Twin-engined General Utility triphibian or amphibian flying-boat.

WINGS.—High-wing cantilever monoplane. All-metal structure. Wing in three sections a centre-section permanently attached to hull and two outer sections. Wing area 833 sq. ft. (77.5 m.²).

HULL.—Two-step all-metal hull.

TAIL UNIT.—Cantilever monoplane type. Fin integral with hull. Tailplane span 29 ft. (8.84 m.).

LANDING GEAR.—Retractable nose-wheel type. Main wheels raised into sides of hull, twin nose wheels into nose of hull. Hydraulic retraction. Wheel track 17 ft. 8 in. (5.38 m.). Wheelbase 17 ft. 6 in. (5.34 m.).

POWER PLANT.—Two Wright R-1820-76A nine-cylinder radial air-cooled engines each with a normal rating of 1,275 h.p. from S.L. to 3,000 ft. (915 m.), 975 h.p. at 14,700 ft. (4,480 m.) and with 1,425 h.p. available for take-off. Three-blade Hamilton Standard constant-speed and reversing airscrews. Internal fuel in two tanks in centre-section outboard of hull with total capacity of 675 U.S. gallons (2,550 litres). Drop tanks of 100, 150 or 300 U.S. gallons (378, 567 or 1,135 litres) each may be carried on bomb-racks under centre-section, one on each side of hull. Each wing-tip float can carry a further 200 U.S. gallons (756 litres).

ACCOMMODATION.—Crew of four/six, pilot, co-pilot, navigator, radio/radar operator and, on special hospital missions, two medical attendants. Cabin may be adapted for various missions. As an ambulance 12 stretchers can be carried and for transport work 10 passengers in addition to crew of four. With seats removed cargo or special equipment can be accommodated. A "dutch-type" door is provided on port side for sea rescue operations or for loading stretchers. Door is split horizontally, the lower half being left in place to give higher freeboard in rough weather. A rescue platform may be attached to bottom door sill from which a crewman secured by safety belt may haul persons aboard from water. Smaller emergency door on starboard side. Both doors may be used for oblique photography and for handling sea anchor. Hatch in roof to facilitate loading of freight. Three life-rafts carried, two in cabin, and one of automatically inflatable type in compartment in top of hull aft of wing. Auxiliary power-plant in compartment aft of main cabin. Lavatory and tail compartment for stowing equipment and gear.

EQUIPMENT.—Racks under each wing can carry bombs, auxiliary fuel tanks, rescue boat or other packaged equipment. Radome on nose of hull. Provision for Jato units to be attached to cabin doors from inside of hull. Stowage for four Jato units below cabin floor between wheel wells. Stowage for two parachute flares in tail compartment. Separate oxygen supplied for crew and passengers with 20 outlets for oxygen masks in cabin.

DIMENSIONS (SA-16A and UF-1).—Span 80 ft. (24.4 m.).

Length 60 ft. 8 in. (18.5 m.).
Height 24 ft. 3 in. (7.3 m.).
DIMENSIONS (SA-16B).—
Span 96 ft. 6 in. (29.41 m.).
Length 62 ft. 4 in. (19.00 m.).
Height 26 ft. 11 in. (8.21 m.).
WEIGHTS AND LOADINGS (SA-16A and UF-1).—
Weight empty 20,100 lb. (9,125 kg.).
Weight loaded 27,025 lb. (12,270 kg.).
Wing loading 32.4 lb./sq. ft. (158.1 kg./m.²).
Power loading 10.6 lb./h.p. (4.81 kg./h.p.).
WEIGHTS (SA-16B).—
Weight empty 25,600 lb. (11,612 kg.).
Normal loaded weight 32,100 lb. (14,560 kg.).
Max. loaded weight 35,600 lb. (16,148 kg.).
PERFORMANCE (SA-16A and UF-1).—
Max. speed at S.L. 247 m.p.h. (395 km.h.).
Max. speed at 18,800 ft. (5,735 m.) 264.5 m.p.h. (423 km.h.).
Cruising speed 225 m.p.h. (360 km.h.).
Stalling speed 79 m.p.h. (126.4 km.h.).
Initial rate of climb 1,400 ft./min. (427 m./min.).
Take-off distance at S.L. (no wind) 900 ft. (275 m.).
Take-off distance against 25 m.p.h. (40 km.h.) wind (off land) 330 ft. (100 m.).
Range (with 600 U.S. gallons = 2,270 litres external fuel) 2,700 miles (4,320 km.).
Endurance (with 600 U.S. gallons = 2,270 litres external fuel) 22.9 hours.

GYRODYNE

GYRODYNE COMPANY OF AMERICA, INC.

HEAD OFFICE AND WORKS: FLOWERFIELD, ST. JAMES, LONG ISLAND, NEW YORK.

President and Treasurer: Peter J. Papadakos.

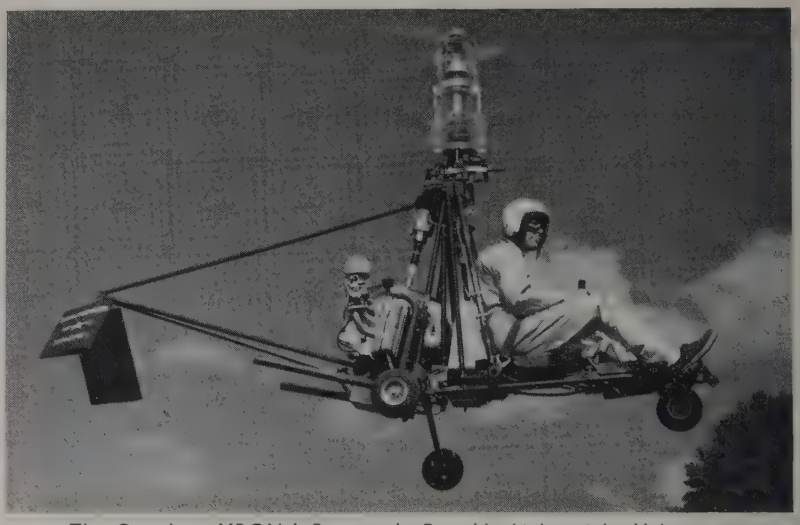
Comptroller: Joseph J. Dorn.

Secretary: Nicholas Xanthaky.

The Gyrodyne Company of America, Inc. (originally organised under the name P.C. Helicopter Corpn). was incorporated in New York State on August 7, 1946. The company was formed for the purpose of developing advanced types of rotary-wing aircraft.

Under contract to the U.S. Navy Bureau of Aeronautics, the company is currently engaged in the development of the XRON-1 Rotorcycle, a one-man co-axial helicopter. This project is described in detail below.

The company also has in the design stage a light and simple two-seat co-axial helicopter on lines similar to the XRON-1.



The Gyrodyne XRON-1 Rotorcycle Portable Lightweight Helicopter.

THE GYRODYNE ROTORCYCLE.
U.S. Navy designation: XRON-1.

The XRON-1, which is under development for the U.S. Navy Bureau of Aeronautics, was originally conceived as a small light simple one-man portable helicopter intended for use by the U.S. Marine Corps for "observation, liaison and small unit tactical manoeuvres."

Its concept emerged from a design competition held by the U.S. Navy in late 1953, for a small one-man helicopter which could be readily collapsed into a small package for easy transportation and which could be quickly assembled by one man in the field. Based on this concept the prototype XRON-1 was designed, built and flown in less than one year from the date of the contract. The original power-plant was a 40 h.p. Nelson engine.

Subsequent to the successful flight testing of the original prototype, which began in November, 1955, additional uses for the XRON-1 were found which called for the use of larger engines.

Currently the XRON-1 incorporates the Porsche 1,600 c.c. modified automotive-type engine developing 60 h.p. at 4,000 r.p.m. As the result of the success of this installation, arrangements have been made with the Porsche company of Stuttgart, Germany, to furnish engines specifically designed for the XRON-1.

The company has plans to certificate the Rotorcycle for commercial use, but because of military commitments it is not expected that a commercial model will be available for at least eighteen months.

TYPE.—Single-seat Helicopter.

ROTOR SYSTEM.—Two two-blade co-axial contra-rotating rotors. Blades of semi-rigid type and of laminated wood construction, two moulded halves being bonded together to form blade. Blade aerofoil NACA 00 Series.

ROTOR DRIVE.—By universal shaft from engine to transmission unit at top of rotor mast. Transmission unit includes clutch, rotor brake, free-wheeling unit and main transmission drive. Drive is composed of five spiral bevel gears in two stages. Second stage has pinion between two opposing ring gears which set up counter-rotation. Clutch in two parts, a friction clutch to bring rotors up to engine speed and a positive jaw clutch which is engaged after rotor and engine speeds are synchronised. Entire transmission and rotor mast is pressure-lubricated.

FUSELAGE.—Consists of an aluminium tubular structure to which are attached the pilot's seat and controls, power-unit, transmission and rotor mast and landing-gear. A tubular tail truss carries the inverted-Vee tail.

TAIL UNIT.—Inverted-Vee tail surfaces are fixed and provide longitudinal and directional stability in forward flight.

LANDING GEAR.—Tricycle type.

POWER PLANT.—One 60 h.p. Porsche modified automotive-type four-cylinder opposed two-stroke fan-cooled engine. Drive shaft to transmission unit has universal joint at each end to accommodate mis-alignments arising from torsional movement of engine on its mounting. Manual starting.

ACCOMMODATION.—Pilot's seat located immediately forward of rotor centre-line and supported by fuselage tubular structure. Provision for parachute.

CONTROLS.—Cyclic-pitch control by conventional floor stick. Collective pitch lever with twist-grip throttle control at pilot's left hand. Directional control by rotor-tip brake system operated by rudder bar.

DIMENSIONS.—
Rotor diameter 17 ft. (5.18 m.).
Fuselage length 11 ft. 0.56 in. (3.36 m.).
Overall height 7 ft. 3 in. (2.21 m.).
Overall width 5 ft. 4 in. (1.62 m.).

WEIGHT.—
Including 180 lb. (82 kg.) pilot and 60 lb. (27.2 kg.) pack 645 lb. (293 kg.).

PERFORMANCE.—
Max. speed at S/L 73 m.p.h. (117 km.h.).
Max. rate of climb at S/L 945 ft./min. (288 m./min.).
Service ceiling 10,400 ft. (3,170 m.).
Vertical rate of climb at S/L 500 ft./min. (152 m./min.).
Hovering ceiling out of ground effect 2,800 ft. (854 m.).
Range in normal loaded condition 26.5 miles (42.4 km.).

HAYDEN

HAYDEN AIRCRAFT CORPORATION.

HEAD OFFICE: 10451, E. CENTER STREET, BELLFLOWER, CALIFORNIA.

President and Chairman: Robert E. Hayden.

The Hayden Aircraft Corporation was incorporated on January 15, 1955, to build the Bushmaster 15-AT. This aircraft has been designed by the application of modern engineering techniques to the basic airframe of the Ford Tri-Motor, which was designed in its original form by the late William B. Stout in 1926.

Design and engineering changes are being flight tested on an original Tri-Motor, and an initial series of three Bushmasters is being built. The first of these was scheduled to fly towards the end of 1958, and the details given below refer to this aircraft. Production machines, for which manufacturing and financial support are being given by Aircraft Hydro-Forming, Inc., will differ in a few minor details.

THE STOUT BUSHMASTER 15-AT.

TYPE.—Three-engined Passenger and Freight Transport.

WINGS.—High-wing cantilever monoplane. Aerofoil section Ford No. 2. Aspect ratio 7.3. Chord 12 ft. 10 in. (3.91 m.) at root, 7 ft. 8 in. (2.33 m.) at tip. Incidence —3° at root, 0° at tip. All-metal structure with three main and five auxiliary aluminium spars. No ribs. Corrugated aluminium skin formed to aerofoil. All-metal ailerons with corrugated aluminium skin on aluminium formers. No flaps on prototype, but flaps will be fitted to production aircraft. Total area of ailerons 52 sq. ft. (4.83 m.²). Gross wing area 843 sq. ft. (78.32 m.²).

FUSELAGE.—Rectangular section all-metal structure. Corrugated aluminium skin on box frame of rolled U-section members. (Substantially the same as Ford 5-AT, but 18 in. = 0.46 m. wider in cargo section).

TAIL UNIT.—Cantilever monoplane type. All-metal construction, with corrugated aluminium skin over formers. Areas: fin 15.7 sq. ft. (1.46 m.²), rudder 24.2 sq. ft. (2.24 m.²), elevators 72.4 sq. ft. (6.73 m.²), tailplane 46.8 sq. ft. (4.35 m.²). Tailplane span 21 ft. 2 in. (6.45 m.).

LANDING GEAR.—Fixed tail-wheel type. Oleo shock-absorbers. Goodyear 11.00-12 aluminium disc wheels. Goodyear single disc brakes. Wheel track 20 ft. (6.10 m.). Wheelbase 35 ft. 6 in. (10.82 m.). Float or ski landing gear optional.

POWER PLANT.—Three 450 h.p. Pratt & Whitney R-985 Wasp Junior nine-cylinder radial air-cooled engines, reconditioned in approved shops to factory standards. Hamilton Standard two-blade constant-speed airscrews with Type 2D-30 hub and Type 6101A-14 or -16 blades. All fuel in three wing tanks, each of 100 U.S. gallons (378 litres) capacity. Total oil capacity 30 U.S. gallons (114 litres).

ACCOMMODATION.—Crew of two with dual controls. Nineteen folding seats in passenger version as optional equipment. Basic aircraft is cargo transport with

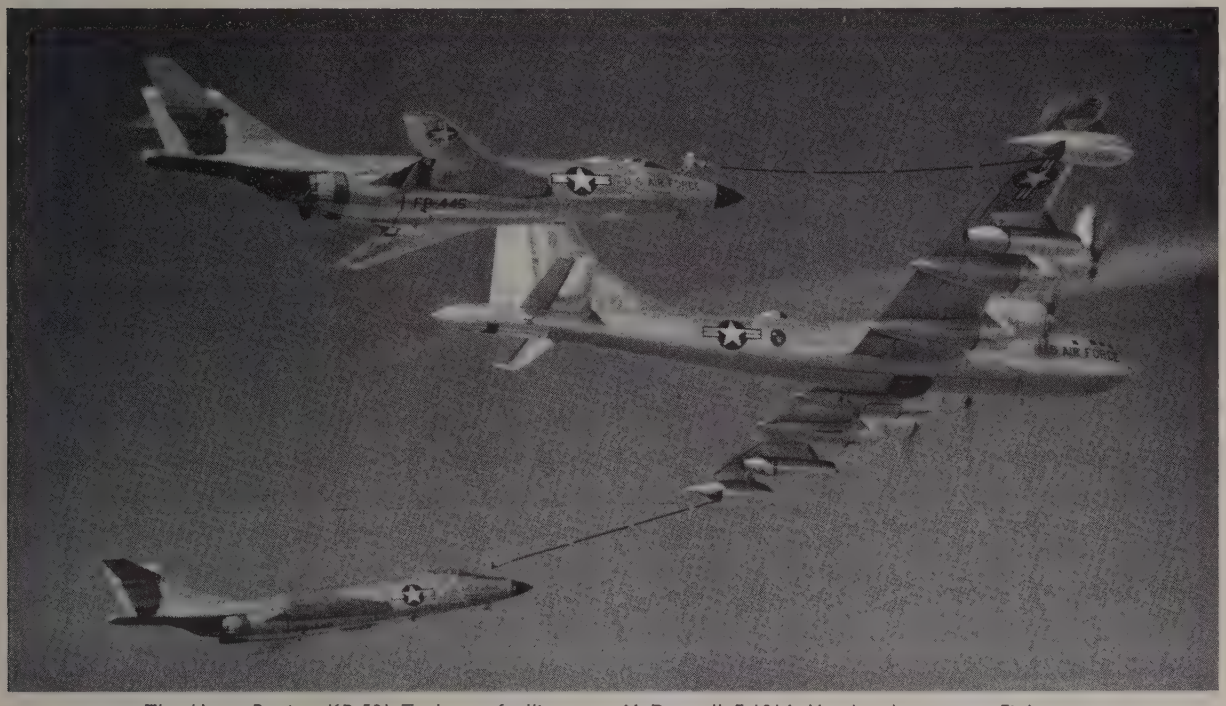
reinforced floor. Cabin dimensions 20 ft. long × 6 ft. wide × an average 6 ft. high (6.10 m. × 1.83 m. × 1.83 m.). Volume 720 cub. ft. (20.39 m.³). Cargo loading door on port side size 5 ft. × 5 ft. 10 in. (1.52 m. × 1.78 m.).

DIMENSIONS.—
Span 79 ft. 4 in. (24.18 m.).
Length 50 ft. 4 in. (15.34 m.).
Height 15 ft. 1 in. (4.60 m.).

WEIGHTS.—
Weight empty 6,800 lb. (3,085 kg.).
Weight loaded 12,500 lb. (5,670 kg.).

PERFORMANCE.—
Max. speed 145 m.p.h. (234 km.h.).
Cruising speed 125 m.p.h. (201 km.h.).
Stalling speed (flaps down) 45 m.p.h. (72 km.h.).
Range 600 miles (965 km.).
Take-off distance (with flaps), empty 100 ft. (30 m.).
Take-off distance (with flaps), full load 600 ft. (183 m.).

HAYES



The Hayes-Boeing KB-50J Tanker refuelling two McDonnell F-101A Voodoo long-range Fighters.

HAYES AIRCRAFT CORPORATION.

HEAD OFFICE AND WORKS: BIRMINGHAM, ALABAMA.

President: Lewis F. Jeffers.

Executive Vice-President: N. F. Vanderlipp.

Hayes Aircraft Corporation was founded in the Spring of 1951 by the late Harry T. Rowland. Initially, it undertook the overhaul and modification of B-25 Mitchell bombers and C-119 transport aircraft for the U.S.A.F. A subsequent contract for IRAN (inspect and repair as necessary) work on C-124 Globemaster transports has been followed by a large contract for similar work on KC-97 Stratofreighter tanker-transports which were still passing through the company's workshops in 1958.

In addition, Hayes is converting a large number of B-50 Superfortress bombers into KB-50J flight refuelling tankers. It also maintains a staff of several hundred employees at Fort Rucker, Alabama, for maintenance of U.S. Army aircraft and helicopters, and a staff of engineers at Redstone Arsenal, Alabama, on missile work.

THE HAYES-BOEING KB-50J SUPERFORTRESS.

The KB-50J is the Boeing B-50 Superfortress bomber as modified by Hayes Aircraft Corporation into a three-point flight refuelling tanker for the U.S.A.F. This work involves complete internal redesign and re-manufacture of the airframe, with new and elaborate electrical, hydraulic, electronic and fuel flow systems. Almost 25 short tons of fuel can be carried by each modified aircraft.

Probe-and-drogue type hose-reel units are mounted in self-contained pods under the aircraft's wing-tips and in the extended tail-cone. In addition, the four standard Pratt & Whitney R-4360 piston-engines are supplemented by two new under-wing pods, each containing a General Electric J47 turbojet engine. These enable the KB-50J to be used for high-altitude refuelling of jet aircraft.

HELIO

HELIO AIRCRAFT CORPORATION.

HEAD OFFICE: BOSTON METROPOLITAN AIRPORT, NORWOOD, MASS.

WORKS: PITTSBURG, KANSAS.

President and Chairman of the Board: Dr. L. L. Bollinger.

Vice-President: Dr. O. C. Koppen.

Manager and Chief Engineer: Lawrence N. Smithline.

The original Helio Aircraft Company was formed by Dr. Otto C. Koppen of the Massachussetts Institute of Technology, and Dr. Lynn Bollinger, of the Harvard Graduate School of Business Administration, to develop a light aircraft of greater potential utility than any existing type. Quick take-off and climb, high cruising speed, fully-controllable flight at low speeds, freedom from stall and spin, low landing speed, etc., were some of the qualities aimed at.

The original prototype consisted of an extensively rebuilt Piper Vagabond light aircraft. It first flew on April 8, 1949, and has been described fully in earlier editions of this annual.

After considerable flight testing of this prototype, the Helio Aircraft Corporation designed a new four-seat aircraft known as the Helioplane-Four. At first, it incorporated most of the novel design features of the prototype; but was later redesigned and re-engined.

Now known as the Helio Courier, this aircraft first flew in its new form in 1953, and was followed by the first production aircraft in 1954. It is an all-metal cantilever high-wing monoplane incorporating full-span automatic leading-edge slots and a high-lift flap system.

The Courier has been awarded C.A.A. Type Certificate 1A8 and is being built by Mid-States Manufacturing Corporation, of Pittsburg, Kansas. This company was acquired by Helio Aircraft Corporation in July, 1956.



The Helio Courier (260 h.p. Lycoming engine).

During 1956, a floatplane version of the Courier was produced, followed early in 1957 by the Helio H-392 Strato-Courier with more powerful supercharged engine.

THE HELIO H-391B COURIER.

By March, 1958, a total of 86 Couriers had been built, of which 71 were being used for executive and industrial flying. A floatplane version is also available, with similar short take-off and landing characteristics and a cruising speed of 139 m.p.h. (223 km.h.).

TYPE.—Five-seat Light Monoplane.

WINGS.—High-wing cantilever monoplane. NACA 23012 wing section. Aspect ratio 6.58. Chord 6 ft. (1.83 m.). Dihedral 1°. Incidence 3°. All-metal single-spar structure. Full-span automatic leading-edge-slats. NACA high-lift slotted all-metal flaps over 74% of span. Frise-type ailerons have duralumin frames and fabric covering. Total area of ailerons 20.7 sq. ft. (1.92 m.²). Total area of flaps 38.1 sq. ft. (3.54 m.²). Gross wing area 231 sq. ft. (21.46 m.²).

FUSELAGE.—All-metal structure. Cabin section has steel-tube framework, rear section is an aluminium monocoque.

TAIL UNIT.—Cantilever monoplane type. All-metal structure. There is no fixed tailplane. Areas: fin 15.20 sq. ft. (1.41 m.²), rudder 10.60 sq. ft. (0.99 m.²), one-piece "flying tail" 37.5 sq. ft. (3.48 m.²). Span of tail 13 ft. 4 in. (4.06 m.).

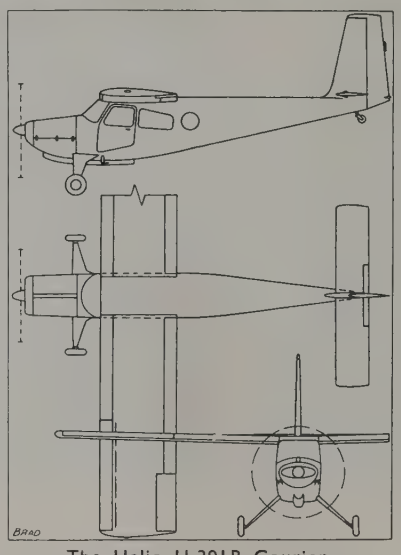
LANDING GEAR.—Fixed tail-wheel type. Cantilever struts with oleo-pneumatic springing. Goodyear cross-wind landing-gear optional. Goodyear wheels and hydraulic brakes. Track 9 ft. (2.74 m.). Wheelbase 23 ft. 5 in. (7.14 m.). Alternative floatplane landing gear.

POWER PLANT—One 260 h.p. Lycoming GO-435-C2B2-6 six-cylinder horizontally-opposed air-cooled geared engine. Ejector tube engine cooling. Hartzell 101 two-blade constant-speed airscrew. Two 30 U.S. gallon (113 litre) wing tanks. A 25 U.S. gallon (94.5 litre) auxiliary tank is available to take place of fifth seat. Oil capacity 2½ U.S. gallons (9.45 litres).

ACCOMMODATION.—Cabin seats four in two pairs, with provision for fifth seat in rear baggage compartment. Dual controls for front seats. CAA standard instrument panel. Aerodynamically positive (fully non-stallable) control system. Special over-strength cabin and seat structure based on Flight Safety Foundation recommendations. Two large doors at left front and right rear. Large baggage compartment (200 lb. = 91 kg. capacity) behind rear seats.



The Helio H-391B Courier Seaplane (260 h.p. Lycoming GO-435 engine).



The Helio H-391B Courier.

If rear seats are removed a 6 ft. (1.83 m.) long cargo compartment is available for 1,000 lb. (454 kg.) industrial loads.

DIMENSIONS (Landplane).—
Span 39 ft. (11.89 m.).
Length 30 ft. (9.15 m.).
Height 8 ft. 10 in. (2.69 m.).

WEIGHTS AND LOADINGS (Landplane).—
Weight empty 1,880 lb. (853 kg.).
Weight loaded (normal category) 3,000 lb. (1,362 kg.).
Wing loading 13 lb./sq. ft. (63.5 kg./m.²).
Power loading 11.5 lb./h.p. (5.22 kg./h.p.).

PERFORMANCE (Landplane).—
Cruising speed 162 m.p.h. (261 km.h.) at 8,500 ft. (2,590 m.).
Min. speed (power on) under 30 m.p.h. (49.6 km.h.).
Initial rate of climb 1,300 ft./min. (400 m./min.).
Service ceiling 23,100 ft. (7,040 m.).
Range 700 miles (1,127 km.).
Max. range with auxiliary tank 975 miles (1,560 km.).
Take-off distance to 50 ft. (15.25 m.) 500 ft. (152 m.).
Landing distance from 50 ft. (15.25 m.) 500 ft. (152 m.).

THE HELIO H-392 STRATO-COURIER.

Basically similar to the H-391B Courier, the H-392 differs mainly in having a 340 h.p. Lycoming GSO-480-A1A6 supercharged six-cylinder horizontally-opposed air-cooled engine, driving a three-blade Hartzell Automatic constant-speed airscrew.

Intended mainly for high-altitude photographic work, the Strato-Courier operates as an industrial aircraft under CAR 8 requirements at over 30,000 ft. (9,145 m.) with full payload. Its high wing and absence of struts also make it suitable for low-altitude oblique photography.

On October 18, 1957, a Strato-Courier flown by Luis Struck, head of the Mexican Servicio Aerotecnico, and accompanied by Claudio Robles Ochoa, assistant director of the Mexican Civil Aeronautics Department, set up an international height record for light aircraft weighing less than 1,700 kg. (3,740 lb.) by reaching a height of 9,516 m. (31,200 ft.) over Mexico City.

WEIGHTS.—
Weight empty 2,020 lb. (917 kg.).
Weight loaded 3,200 lb. (1,452 kg.).

PERFORMANCE.—
Max. speed 194 m.p.h. (312 km.h.).
Cruising speed 182 m.p.h. (293 km.h.).
Min. flying speed 30 m.p.h. (49.6 km.h.).
Rate of climb at S/L over 2,000 ft./min. (610 m./min.).
Climb to 30,200 ft. (9,200 m.) 50 min.
Take-off distance to 50 ft. (15.25 m.) in still air, 300 ft. (91 m.).
Landing distance in still air 225 ft. (69 m.).
Max. still air range over 1,000 miles (1,610 km.).



The Helio H-392 Strato-Courier (340 h.p. Lycoming GSO-480 engine).

HILLER

HILLER AIRCRAFT CORPORATION.

HEAD OFFICE: 1,350, WILLOW ROAD, PALO ALTO, CALIFORNIA.

WASHINGTON OFFICE: 1,632 K STREET, N.W., WASHINGTON, D.C.

President: Stanley Hiller, Jr.

Executive Vice-President and General Manager: E. T. Bolton.

Vice-Presidents: A. J. M. Chadwick, A. W. B. Vincent and D. W. Elam.

Director of Advanced Research: Frank A. Heileman.

Chief Engineer: Robert A. Wagner.

Secretary and Treasurer: James T. Dresher.

During 1958, Hiller Aircraft Corporation continued as its main production activity the building of H-23 military helicopters for the U.S. Army, together with the commercial version of this aircraft, known as the Hiller UH-12.

Research and development in the fields of rotor-tip jet propulsion and ducted airscrew propulsion continued. In particular, large tip-turbine powered helicopter configurations continued under study as a logical extension of experience gained in designing, building and flying the H-32 ramjet helicopter.

A number of large and small aircraft powered by single and multiple ducted airscrews were designed as a continuation of Hiller's work on one-man "Flying Platform" type aircraft.

Under U.S.A.F. contract, construction of the X-18 tilt-wing research transport was completed during the year and preliminary tests were started. A six-month wind tunnel test programme with an 8 ft. (2.44 m.) model of this aircraft was completed in an N.A.C.A. tunnel at Langley Field, Virginia.

Among studies in progress at the company's Advanced Research Division were "Static Lift from Vortex Motion" for the

U.S.A.F.; "Static Characteristics of Jet Slots," "Resonant Combustion" and "Ducted Aircrew Weight Lifter" for the U.S. Navy; and an operations analysis of amphibious assault tactics for the U.S. Marine Corps.

THE HILLER X-18.

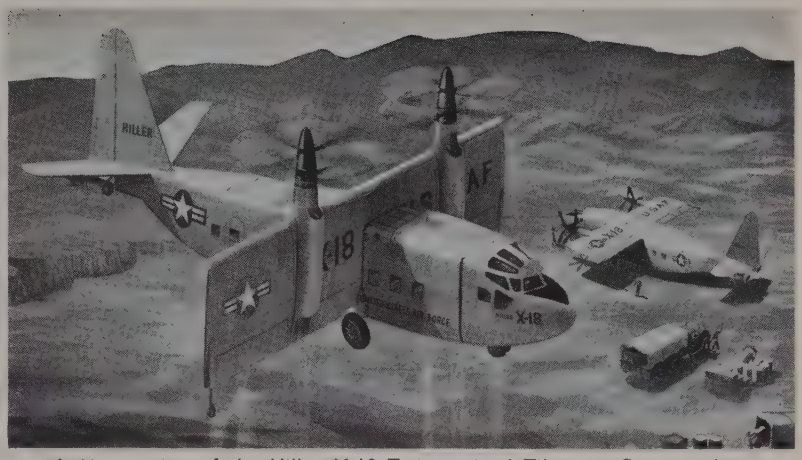
In February, 1957 the U.S. Air Force awarded Hiller an initial contract for the development of a twin-engined tilting-wing convertiplane to be designated X-18.

This had to be capable of vertical take-off and landing, as well as forward speeds of up to 400 m.p.h. (640 km.h.).

Although it is the largest of the higher-speed V.T.O. aircraft so far built in the United States and is unconventional by present standards, its construction has not required the use of a large number of completely new and unconventional components. The X-18's wings, transmissions, airscrews, engines and systems are essentially the same as those used in conventional fixed-wing aircraft, and the prototype has, in fact been designed around the fuselage of a Chase YC-122 transport, at considerable saving in time and cost.

The high-set wing is designed to pivot through 90 degrees for vertical take-off, so that the airscrews work in a similar way to the rotors of a helicopter. During cruising flight, the X-18 will look and work like a conventional twin-engined transport aeroplane, but with much less wing area than is usual.

When airfields are available, it will be able to operate as a conventional fixed-wing transport with increased payload.



An impression of the Hiller X-18 Twin-engined Tilt-wing Convertiplane.

THE HILLER XROE-1.

Hiller was successful in winning one of two contracts awarded by the U.S. Navy Bureau of Aeronautics in 1954 for the development and production of a prototype one-man portable "rotorcycle" for the U.S. Marine Corps.

The first flight of this aircraft, which is designated XROE-1, was announced by the U.S. Navy on January 10, 1957, and the aircraft had completed its official flight test programme by July of that year.

The XROE-1 is so designed that it can be folded by one man into a small package for easy transportation or parachute drop. From its completely-folded state, it can be assembled and flown in a matter of minutes. Folding parts are secured in place by 13 standard quick-release pins.

Although not literally a strap-on rotorcycle, the XROE-1 comes close to this concept. Its uses include observation, liaison and small unit tactical manoeuvres.

The following details apply to the developed version of the XROE-1.

TYPE.—One-man Utility helicopter.

ROTOR SYSTEM.—Two-blade main rotor mounted on power shaft with small servo rotor (Hiller Rotor-Matic control system). Movement of the cyclic control stick introduces to the servo rotor paddles positive or negative changes, and aerodynamic forces thus developed tilt the rotor head and produce the effect of cyclic pitch changes on the rotor blades. The two-blade anti-torque rotor is driven off the engine through a universal joint and shafting. The main rotor blades are of all-metal construction, as are the tail rotor blades, which are covered with a metal skin.

FUSELAGE.—Semi-monocoque pylon structure of aluminium sheet, stiffeners, and formers.

LANDING GEAR.—Three double-tapered aluminium-alloy spring tubes. Landing gear track 8 ft. 4 in. (2.54 m.).

POWER PLANT.—One 45 h.p. Nelson Model H-63 four-cylinder horizontally-opposed air-cooled two-stroke engine. Transmission is driven through a centrifugal clutch, ultimately giving smooth engagement at approximately 1,800 r.p.m.

ACCOMMODATION.—The collective stick, incorporating a twist grip throttle control, is in conventional location beside the single seat. The cyclic stick is an over-head type, chosen to avoid the complicated linkages involved in a floor-type installation. Rudder controls consist of a conventional pedal and cable system. Instruments, located on the forward landing tube, will ultimately consist of only a tachometer and provision for reading minutes of fuel remaining and total flight time of the helicopter. A small pack or wire drum or other light cargo may be attached to or slung directly below the pilot's seat. Additional fuel tanks may be attached to the main pylon or under seat.

DIMENSIONS.—
Main rotor diameter 18 ft. 6 in. (5.63 m.).
Height to top of rotor head 6 ft. 11 in. (2.10 m.).
Diameter of tail rotor 3 ft. 0 in. (0.91 m.).

WEIGHTS AND LOADINGS.—
Weight empty 300 lb. (136 kg.).
Weight loaded 556 lb. (252 kg.).

PERFORMANCE.—
Max. speed 70 m.p.h. (113 km.h.).
Cruising speed 52 m.p.h. (84 km.h.).
Max. rate of climb 1,160 ft./min. (355 m./min.).
Hovering ceiling in ground effect 9,200 ft. (2,800 m.).
Service ceiling 13,200 ft. (4,025 m.).
Range at S/L with 170 lb. (77 kg.) pilot and 86 lb. (39 kg.) fuel 166 miles (267 km.).



The Hiller XROE-1 Single-seat Portable Helicopter (45 h.p. Nelson engine).

THE HILLER MODEL HJ-1 HORNET.
U.S. Army designation: YH-32.
U.S. Naval designation: HOE-1.

The Hornet is a small two-seat ramjet-powered helicopter, of which 12 were procured by the U.S. Army and 3 by the U.S. Navy for evaluation.

The Hiller 8RJ2B ramjet engine which powers the Hornet was, in October, 1954, awarded an Approved Type Certificate by the C.A.A. The engine thus became the first ramjet power-unit to be certificated in the United States and also the first CAA-approved tip-mounted power-plant for helicopters. Details of this power-unit will be found in the Engine Section of this book.

A detailed description of the Hornet has appeared in previous editions of "All the World's Aircraft." Its general configuration is shown in the accompanying illustration.

DIMENSIONS.—
Rotor diameter 23 ft. (7.0 m.).
Fuselage width 3 ft. 9 in. (1.14 m.).
Overall height 7 ft. 10 in. (2.38 m.).

WEIGHTS.—
Empty 544 lb. (246 kg.).
Max. useful payload 536 lb. (243 kg.).
Loaded 1,080 lb. (489 kg.).
PERFORMANCE.—
Cruising speed 69 m.p.h. (111 km.h.).
Initial rate of climb 700 ft./min. (215 m./min.).
Service ceiling 6,900 ft. (2,100 m.).
Normal still air range 28 miles (45 km.).
Endurance 25 min.

THE HILLER YH-32A (ULV).

The YH-32A (ULV) is a special lightweight version of the H-32, which has been developed as a rocket-firing platform under contract from the U.S. Army Ordnance Corps. To reduce weight and ensure a minimum-size target for ground-fire, the cabin structure has been removed and replaced by a small transparent windshield. The normal monocoque tail-boom is replaced by two small-diameter tubes, each carrying a square vertical tail-surface at its extremity. Three tubular rocket-launchers are carried on the landing gear structure above each tubular skid.

Tests of the YH-32A (ULV) have been conducted under the direction of the Aberdeen Ballistic Research Laboratory, with the support of Fort Rucker's experimental "Air Cavalry" platoon and the Rocket Development Laboratory of Redstone Arsenal.



The Hiller HOE-1 Hornet Ramjet-driven Helicopter. (*Gordon Williams*).



The Hiller H-23D Military Helicopter (250 h.p. Lycoming engine).

THE HILLER MODEL UH-12.
U.S. Army designation: H-23 Raven.
U.S. Navy designation: HTE.

The H-23D, now in production for the U.S. Army, is the latest model of the H-23 series of training and utility helicopters designed specifically for military use. A total of more than 900 have been delivered and commercial versions are also in production.

Civil and military versions of the H-23 are as follows :—

H-23B. Air evacuation helicopter for the U.S. Army with 200 h.p. Franklin Model 6V4-200-C33 engine. Stretcher installation consists of two folding stretchers in heated carriers, one on each side of cabin. May also be used for training. Wide track skid landing-gear.

H-23C. 1956-57 production version for U.S. Army with same engine as H-23B. Full bubble-type canopy, re-designed rotor hub and cyclic control scissors, size of instrument panel reduced by one-third, improved engine and tail rotor system. First H-23C delivered on December 6, 1955.

H-23D. Fitted with 250 h.p. Lycoming engine, new transmission system designed for 1,000 hours' service between overhauls and capable of absorbing up to 300 h.p. and a new tail rotor assembly. First prototype flew on April 3, 1956, and first deliveries were made in December, 1957. Present contracts extend production well into 1959.

HTE-2. Two-seat training version of H-23B for U.S. Navy. Four-wheel landing-gear.

UH-12-B. Commercial version of H-23B. Granted Approved Type Certificate No. 6H2 by the C.A.A. in November, 1951.

UH-12C. Commercial version of H-23C.

UH-12E. Commercial version of H-23D, with 305 h.p. Lycoming engine.

The following details apply specifically to the H-23D, but are generally applicable to other versions :—

TYPE.—Three-seat Utility Helicopter.

ROTOR SYSTEM.—Two-blade main rotor universally mounted on power shaft with small servo rotor, the latter connected directly through universally-mounted transfer bearing and simple linkage with pilot's cyclic control stick. Movement of control stick introduces to the servo rotor paddles positive or negative pitch changes, and aerodynamic forces thus developed tilt the rotor head and produce the effect of cyclic pitch changes to the rotor blades. H-23C and D have expanded main rotor and control rotor tilt stops (9°-12° rotor hub). Two-blade anti-torque rotor at rear end of fuselage driven off engine through universal joint and shafting. Main rotor/engine r.p.m. ratio 1 : 8.64. Anti-torque rotor/engine r.p.m. ratio 1 : 1.45. The main and tail rotor blades are of all-metal construction. Main rotor disc area 985 sq. ft. (91.5 m.²).

FUSELAGE.—Fabricated sheet metal fully-stressed semi-monocoque platform structure supports the non-stressed cabin enclosure, seats and controls, engine mounting and landing-gear. Four-section canopy for ease of shipment and replacement. Tail boom of beaded sheet metal with no internal stiffeners.

LANDING GEAR.—Wide-tread skid. Two small wheels can be fitted at rear to facilitate ground handling. Skid track 7 ft. 6 in. (2.28 m.). Alternative float landing-gear available.

POWER PLANT.—One 250 h.p. Lycoming VO-435-A1C six-cylinder horizontally-opposed fan-cooled engine mounted with main shaft vertical on steel-tube quadrapod attached to fuselage platform by four bolts. Supercharger optional. Rotor transmission through two-stage planetary gear assembly. Normal fuel capacity 48 U.S. gallons (181 litres). Can be fitted with 18 U.S. gallon (64 litres) auxiliary tank. Oil capacity 3.3 U.S. gallons (12.5 litres.).

ACCOMMODATION. — Enclosed bubble-type cabin seating three. Floor type cyclic pitch control columns with collective pitch levers on left side of seats. Electric trim switch on both centre and left-hand cyclic columns, and throttle friction adjustment on collective pitch levers. Large map storage pocket behind starboard passenger seat. The H-23D casualty evacuation version carries two folding type litters, one either side of cabin. Litter carriers are heated. The civil versions can be easily adapted for agricultural operations, using dust, spray or aerosol equipment. Other optional equipment includes air-to-ground broadcast loud-speaker and external net and load sling for freight transport.



The Hiller HTE-2 Naval Training Helicopter.

DIMENSIONS.—
Main rotor diameter 35 ft. 6 in. (10.82 m.).
Fuselage length 27 ft. (8.23 m.).
Height to top of rotor head 9 ft. 8 in. (2.95 m.).
Diameter of tail rotor 5 ft. 6 in. (1.67 m.).
WEIGHTS AND LOADINGS (Model H-23D).—
Weight empty 1,780 lb. (807 kg.).
Weight loaded 2,700 lb. (1,225 kg.).
Power loading 10.8 lb./h.p. (4.9 kg./h.p.).
PERFORMANCE (Model H-23D).—
Max. speed 95 m.p.h. (153 km.h.).
Cruising speed 82 m.p.h. (132 km.h.).
Max. rate of climb at S/L 1,050 ft./min. (320 m./min.).
Vertical rate of climb at S/L 190 ft./min. (58 m./min.).
Hovering ceiling in ground effect 5,200 ft. (1,585 m.).
Hovering ceiling out of ground effect 1,250 ft. (380 m.).
Ceiling 13,200 ft. (4,020 m.).
Range 205 miles (330 km.).

THE HILLER "FLYING PLATFORM."
U.S. Army designation: VZ-1E Pawnee.

The "Flying Platform" is a research vehicle which has been designed and built for the Office of Naval Research mainly to test the principle of stabilised control with the ducted fan type of lift and propulsion system. The co-axial contra-rotating fans are enclosed in a ring, the upper lip of which is flared outward. The induced flow of air through the ring, which is approximately 6 ft. (1.83 m.) in diameter, reduces air pressure over the lip, thus making the pressure under the lip relatively greater and giving the same effect as unshrouded airscrews of 40% greater diameter. The fans are driven through V-belts by two Nelson H-56 air-cooled engines.

The basic structure consists of a centre support and four beams of streamlined section which form a cruciform support for the duct and landing gear. The engines are mounted on the centre fitting and beams, one forward and one behind the pilot. Landing loads are taken by two bungee rings on each landing gear strut.

The duct is made in two pieces, the propeller shroud and inlet duct, and is non-structural. For rigidity, the shroud is of sandwich construction, consisting of 0.012 in. (0.30 mm.) aluminium skins with a foamed-in-place plastic filler. The inlet duct is made of plastic-impregnated Fiberglas.

Fuel is carried in a tank atop the forward engine. The only pilot's control is a twist-grip throttle on the port side of the safety rail, and this controls climb and descent. The pilot shifts his weight or leans in the direction in which he wishes to go, for directional movement.



A mock-up of the Hiller VZ-1E "Flying Platform" (three Nelson H-56 engines).

Hiller received a contract from the U.S. Office of Naval Research for the development of the free flight platform in late 1953. The prototype was completed in September, 1954, and initial tethered tests began on January 21, 1955. The first free flight was made on February 4, 1955.

As a result of subsequent flight trials, the U.S. Army ordered a new prototype in November, 1956 for evaluation under service conditions. Under evaluation in 1958, it is powered by three Nelson H-56 engines, for increased safety, and incorporates other design refinements, including a duct of greater diameter (8 ft. = 2.44 m.).

Both versions of the "Flying Platform" are regarded by Hiller as research vehicles to provide information on the practicability of ducted airscrews for use in advanced, higher speed and/or multiple-duct aircraft.

HOWARD

HOWARD AERO, INC.

HEAD OFFICE AND WORKS: INTERNATIONAL AIRPORT, SAN ANTONIO, TEXAS.

President: D. U. Howard.
Executive Vice-President and General Manager, Manufacturing Division: Thomas Carmichael.
General Manager, Service Division: Robert Robertson.
Vice-President in charge of Sales, Manufacturing Division: Fred R. Hooker.



The Howard Super Ventura Executive Transport (two 2,000 h.p. Pratt & Whitney R-2800 engines).

Howard Aero, Inc., was formed by Mr. D. U. Howard in 1947 as an aircraft service organization specialising in the business aviation market, and is now one of the largest companies of its kind in the world.

The Manufacturing Division of Howard Aero was formed in 1955 and its principal current product is the Super Ventura, a high-speed long-range transport designed and built specifically for business use. The Super Ventura is built around certain basic components of the Lockheed PV-1 Ventura ; but all components are extensively modified, all systems are of entirely new design and manufacture, and the performance of the Super Ventura far exceeds that of the original PV-1.

The first completed Super Ventura made its first flight in May, 1955, and the first production aircraft was delivered in the autumn of the same year to Plymouth Oil Company of Pittsburgh, Penna. Since then Super Venturas have been ordered by other major U.S. corporations.

THE HOWARD SUPER VENTURA.

TYPE.—Twin-engined Executive Transport.

WINGS.—Mid-wing cantilever monoplane. Wing section NACA 23018 at root, NACA 23009 at tip. Aspect ratio 7.08. Chord 13 ft. 9 in. (4.19 m.) at root, 3 ft. 9 in. (1.14 m.) at tip. Dihedral 6° 15′. Incidence 2°. Aluminium-alloy structure. Standard PV-1 aluminium-alloy ailerons. Aluminium-alloy Fowler-type flaps. Total area of ailerons 35.05 sq. ft. (3.25 m.²). Total area of flaps 107.5 sq. ft. (9.98 m.²). Gross wing area 542.9 sq. ft. (50.44 m.²).

FUSELAGE.—Aluminium-alloy semi-monocoque structure.

TAIL UNIT.—Cantilever monoplane type with twin fins and rudders. Aluminium-alloy construction. Areas : fins 29.28 sq. ft. (2.72 m.²), rudders 34.83 sq. ft. (3.23 m.²), tailplane 90.63 sq. ft. (8.42 m.²), elevators 35.32 sq. ft. (3.28 m.²). Tailplane span 23 ft. 2 in. (7.06 m.²).

LANDING GEAR.—Retractable tail-wheel type. Bendix PV-2 type pneumatic shock-absorbers. Hydraulic retraction. Goodyear Convair wheels. Goodyear single-disc spot brakes. Wheel track 15 ft. 4½ in. (4.67 m.). Wheelbase 39 ft. 1 in. (11.91 m.).

POWER PLANT.—Two 2,000 h.p. Pratt & Whitney R-2800-83AM10 eighteen-cylinder two-row air-cooled radial engines driving three-blade Hamilton Standard Type 23E50-6801A-54S airscrews, or two 2,500 h.p. Pratt & Whitney R-2800 CB-17 engines driving four-blade Hamilton Standard Type 24E60-7037A-50 airscrews. Fuel in six tanks, two front (155 U.S. gallons = 586 litres each) and two rear (175 U.S. gallons = 664 litres each) in centre-section and two outer wing tanks (345 U.S. gallons = 1,305 litres each). Total fuel capacity 1,350 U.S. gallons (5,110 litres). Oil capacity 26 U.S. gallons (98.2 litres) per engine.

ACCOMMODATION.—Eight to fifteen passengers.

DIMENSIONS.—
Span 62 ft. 0 in. (18.90 m.).
Length 57 ft. 2 in. (17.42 m.).
Height 12 ft. 6 in. (3.81 m.).

WEIGHT.—
Weight loaded 31,000 lb. (14,060 kg.).

PERFORMANCE.—
Max. speed 370 m.p.h. (595 km.h.).
Cruising speed 300 m.p.h. (483 km.h.).

HUGHES

HUGHES TOOL COMPANY, AIRCRAFT DIVISION.

HEAD OFFICE AND WORKS : CULVER CITY, CALIFORNIA.

Hughes Tool Company has designed and built as a private venture an ultra-light two-seat helicopter known as the Model 269, which is suitable for both military and civil use. The company is also engaged on research in connection with high-speed rotors, design and development of a hot-cycle pressure-jet rotor system, a helicopter propulsion system study and a heavy-lift flying crane parametric design study.

THE HUGHES MODEL 269.
U.S. Army designation: YHO-2.

Design and development of the Hughes Model 269 two-seat ultra-light helicopter began in September, 1955 and the first of two prototypes was test flown only 13 months later. Before the end of 1956, it had completed its major flight test programme and had been demonstrated to a preliminary military evaluation team. The second prototype has been used for tethered endurance tests.

The design emphasis was on simplicity to keep initial and operating costs to a minimum ; and the Model 269 is claimed to handle with extreme ease and to have shown remarkable stability.

An evaluation series of five improved Model 269A's has been ordered by the U.S. Army, under the designation of YHO-2.

TYPE.—Two-seat Ultra-light helicopter.

ROTOR SYSTEM.—Three-blade main rotor with fully-articulated metal blades. Blades are of bonded construction, with constant-section extruded aluminium spar, wrap-around skin and a trailing-edge section. Blade section NACA 0015. Blade chord 6.75 in. (0.17 m.). Rotor blade area (each) 7.03 sq. ft. (0.65 m.²). Total disc area 491 sq. ft. (4.56 m.²). A Vee-belt drive system is used, eliminating need for conventional clutch. Two-blade teetering-type tail anti-torque rotor, shaft-driven directly from belt-drive. Disc area of tail rotor 8.7 sq. ft. (0.81 m.²).

FUSELAGE.—Built-up steel-tube structure, with, in the production version, a one-piece aluminium tube tail-boom.

LANDING GEAR.—Skid-type, mounted on four shock-absorbers. Track 6 ft. 2 in. (1.88 m.).

POWER PLANT.—One 180 h.p. Lycoming O-360-C2B four-cylinder horizontally-opposed air-cooled engine mounted by four bolts below seats. Fuel tank behind cockpit. Gravity-feed fuel system. Fuel capacity 25 U.S. gallons (94.5 litres).

ACCOMMODATION.—Two seats side-by-side under Plexiglas canopy. No side doors. Seat belts and shoulder harness. Dual controls optional. Baggage capacity 100 lb. (45 kg.).

DIMENSIONS.—
Main rotor diameter 25 ft. (7.62 m.).
Tail rotor diameter 3 ft. 4 in. (1.01 m.).
Fuselage length 22 ft. 4 in. (6.80 m.).
Height 8 ft. 4 in. (2.54 m.).

WEIGHTS.—
Weight empty 890 lb. (404 kg.).
Weight loaded 1,550 lb. (704 kg.).
Overload weight 1,750 lb. (794 kg.).

PERFORMANCE.—
Max. speed 90 m.p.h. (144 km.h.).
Cruising speed 75 m.p.h. (121 km.h.).
Rate of climb at S/L. 1,360 ft./min. (415 m./min.).
Normal cruising range 150 miles (240 km.).
Normal endurance 2½ hours.



The Hughes Model 269 Helicopter (180 h.p. Lycoming O-360 engine).

KAMAN

THE KAMAN AIRCRAFT CORPORATION.

HEAD OFFICE AND WORKS : OLD WINDSOR ROAD, BLOOMFIELD, CONNECTICUT.

OTHER WORKS : HARTFORD, SUFFIELD, WINDSOR LOCKS AND MOOSUP, CONNECTICUT.

President : Charles H. Kaman.

Senior Vice-President : E. J. Odlum.

Vice-President and Works Manager : E. J. Conway.

Vice-President and Chief Engineer : J. O. Emmerson.

Vice-President, Public and Industrial Relations : Charles Kirchner.

Vice-President and General Manager, Nuclear Division : K. W. Erickson.

Vice-President and Treasurer : B. F. Clark.

Assistant Vice-President and Director of Flight Test Ops. : W. R. Murray.

Assistant Vice-President, Sub-contracts : J. W. Marshall.

Secretary : J. S. Murtha.

The Kaman Aircraft Corpn. was formed on December 12, 1945, to develop a new helicopter intermeshing rotor and servo flap control system evolved by Mr. Charles H. Kaman.

The first Kaman helicopters ordered into production were the HTK-1 three-seat trainer and HOK-1 four-seat liaison helicopters for the U.S. Navy, both of which utilised this system.

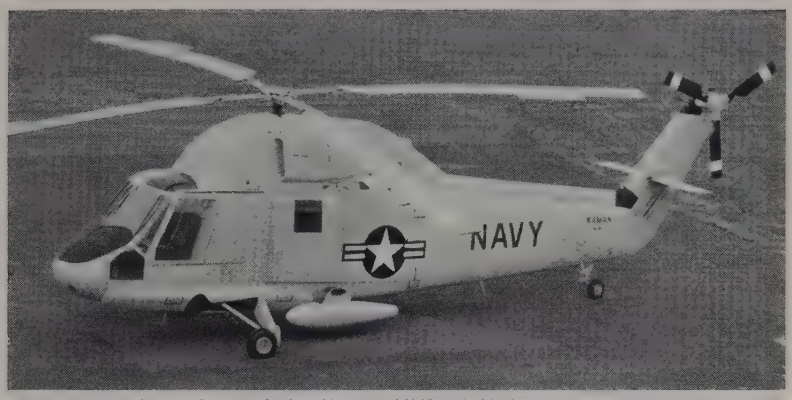
Production of the HTK-1 ended in 1953, and this aircraft has been described fully in previous editions of "All the World's Aircraft." The HOK-1 is still in production for the U.S. Marines and, as the HUK-1, for the U.S. Navy. The U.S.A.F. has also ordered this type for local crash rescue duties, in two versions, of which the H-43A will be a standard piston-engined model, while the H-43B will have a Lycoming T53 shaft-turbine.

Kaman's latest design is the single-rotor HU2K-1 utility helicopter, of which prototypes have been ordered by the U.S. Navy. The company is also developing an STOL aircraft for the U.S. Navy Bureau of Aeronautics, and is engaged on a design study for the U.S. Army of a large "flying crane" helicopter capable of carrying bulk items of heavy cargo over distances of 10-100 miles (16-160 km.). Research work includes the continued development of robot helicopters and rotorchutes of the type described in the 1956-57 edition of this Annual

In August, 1958, it was announced that Kaman was negotiating for licence rights in the British Fairey Rotodyne helicopter, for both military and commercial use.

Kaman is manufacturing components for the McDonnell RF-101 reconnaissance fighter and tools for the Grumman and Martin companies.

The company is also active in the special weapons field and the formation of a new Nuclear Division, located at Albuquerque, New Mexico, was announced in the winter of 1956-57. This Division is engaged in systems analysis and research in the fields of nuclear ordnance and propulsion.



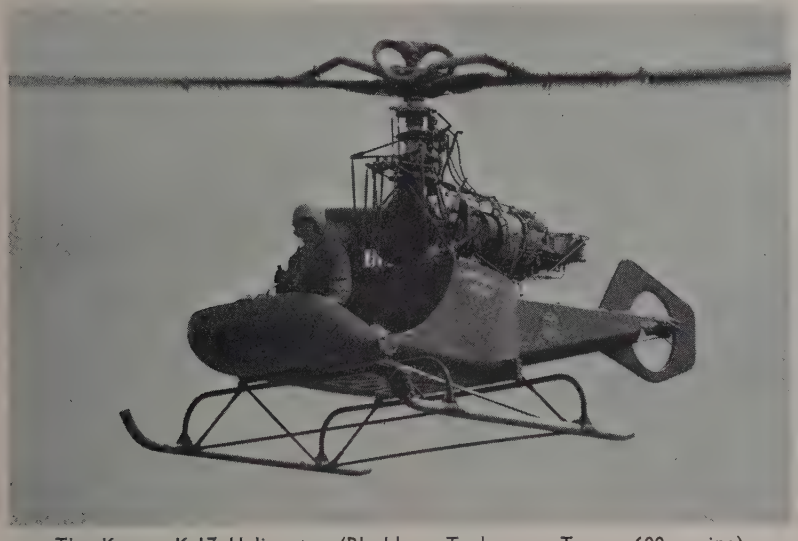
A mock-up of the Kaman HU2K-1 Utility Helicopter.

THE KAMAN HU2K-1.

Kaman entered two designs for a U.S. Navy design competition for a utility helicopter, one with intermeshing rotors and the other with a conventional single rotor. The latter was chosen against strong industry competition, and four prototypes are being built to a Navy contract under the designation of HU2K-1.

TYPE.—Naval Utility Helicopter.

ROTOR SYSTEM.—Four-blade main rotor, three-blade anti-torque tail rotor. Blades of all-metal construction, with servo-flap controls.



The Kaman K-17 Helicopter (Blackburn-Turbomeca Turmo 600 engine).

FUSELAGE.— All - metal semi - monocoque structure.

LANDING GEAR.—Tail-wheel type, with retractable main wheels and fixed tail-wheel. Oleo-pneumatic shock-absorbers.

POWER PLANT.—One 1,100 h.p. General Electric T58 shaft turbine.

DIMENSIONS, WEIGHTS AND PERFORMANCE.—No details available.

THE KAMAN K-17.

Developed as a joint U.S. Army-Kaman project, the K-17 is a light side-by-side two-seat helicopter with a "cold-jet" rotor system, the prototype of which flew for the first time in the Spring of 1958.

It is built around a rigid central structure, comprising a keel and pylon to which all other components are attached. The two seats are mounted on the keel along the sides of the pylon and are supported by a bulkhead. At the front, the keel is extended vertically upward to form a short pylon on which the cockpit instruments are mounted. The prototype was first flown with an open cockpit, but subsequent aircraft will have a light metal-framed plastic cockpit enclosure.

The K-17's 400 h.p. Blackburn-Turbomeca Turmo 600 power plant is mounted aft of the rotor pylon, above the fuselage tail-cone, and drives a Boeing 502 compressor. Air from the compressor is ducted through a rotating seal at the hub of the two-blade rotor, and out through the blades to jet-nozzles at the tips. No combustion takes place at the blade-tips, the rotor being turned simply by air pressure.

The all-metal main rotor is of traditional Kaman design, with servo-flap control to eliminate the need for pitch bearings. A small wooden two-blade fixed-pitch ducted tail rotor is fitted for directional control only. It turns at 3,000 r.p.m., and its direction of rotation is reversed by movement of the pilot's rudder pedals, the system being operated hydraulically by a pump working off the rotor shaft.

Fuel is contained in a single keel-mounted tank, with a capacity of 54 U.S. gallons (205 litres). The structure is completed by a light tubular skid landing gear.

The alternative engine that may be fitted in the K-17 is the new 400 h.p. Boeing XT60-BO-2 shaft-turbine, with which a water-alcohol injection system could be used to maintain take-off power in high ambient temperature conditions.

DIMENSIONS.—
No details available.

WEIGHTS (approx.).—
Weight empty 1,000 lb. (454 kg.).
Payload 700 lb. (318 kg.).

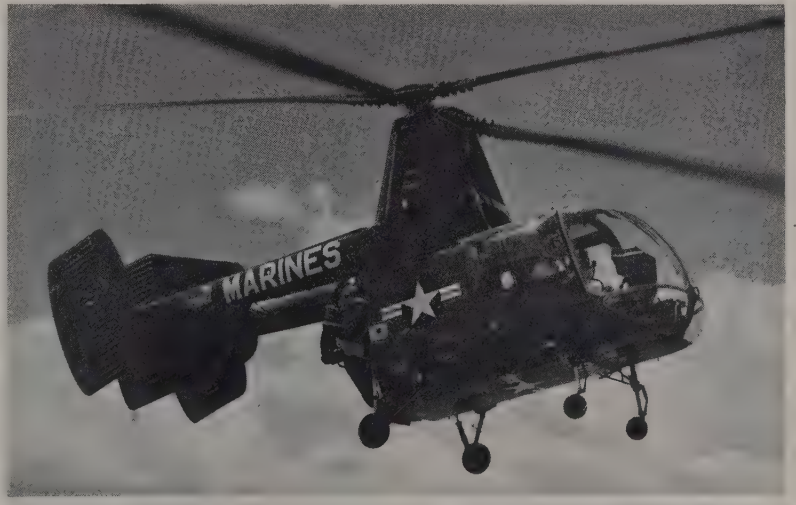
PERFORMANCE (estimated).—
Cruising speed 92 m.p.h. (148 km.h.).
Rate of climb at S/L 1,260 ft./min. (385 m./min.).
Hovering ceiling 5,000 ft. (1,525 m.).
Endurance at S/L 2¼ hrs.

THE KAMAN K-16B.

Under development for the U.S. Navy, the K-16B is a combined VTOL/STOL research aircraft on which the wing incidence will be variable through a considerable angle. It will consist of a Grumman Goose amphibian hull, fitted with a completely new wing and power plant assembly.

The K-16B will be powered by two General Electric T58 turboprop engines, driving Kaman - developed "propeller-rotors" which are fitted with small controllable flaps to give the pilot positive control at speeds between zero and 50 m.p.h. (80 km.h.), when conventional controls are not effective. Above 50 m.p.h. (80 km.h.) the flap control system will phase out automatically.

The wing will tilt during take-off, landing and slow-speed flight, during which periods very large Fowler-type flaps will be extended.



The Kaman HOK-1 Utility Helicopter (600 h.p. Pratt & Whitney R-1340 engine).

THE KAMAN "DRONE" HELICOPTER.

In August, 1952 the Office of Naval Research awarded Kaman a contract to develop a remotely-controlled helicopter. This aircraft is a modified HTK-1, a full description of which has appeared in previous editions of "All the World's Aircraft." It made its first flight under remote control from a ground station in May, 1953, and by April 1956 had progressed to the stage where subsequent flight testing could be entrusted to ground controllers with no piloting experience. One of these "drones" was tested during 1958 with its piston-engine replaced by a lightweight high-voltage A.C. electric motor, supplied by cable from a 250 kw. turbine-driven generator on the ground.

THE KAMAN MODEL 600.

U.S. Navy and Marine Corps designations: HOK and HUK.
U.S.A.F. designation: H-43.

The initial HOK-1 version of this aircraft was ordered into production in 1950, after winning a U.S. Navy design competition for a liaison-type helicopter, and deliveries to the U.S. Marine Corps continued through 1957. Other versions are in production for the U.S. Navy and U.S.A.F.

The standard HOK-1 is a general-purpose helicopter which normally carries four or five persons but can be used also for cargo carrying, medical evacuation, search and rescue and air-to-ground photography. As an ambulance it can accommodate two stretcher patients and one sitting patient or medical orderly, in addition to the pilot. Stretcher loading is through the nose. Optional equipment includes an externally-mounted hook for cargo hauling and a power hoist.



The Kaman HOK-1 powered experimentally by a Lycoming XT53 shaft-turbine.



The Kaman HUK-1 Helicopter (600 h.p. Pratt & Whitney R-1340 engine).

Like the HTK-1 training helicopter, which was ordered into production at the same time, the HOK-1 features the Kaman contra-rotating and intermeshing twin rotor system with servo-flap control. In this system the solid spruce rotor blades are attached to the hub only by blade lag hinges, the servo-flaps eliminating blade-pitch change and associated bearings. The movements of the servo-flaps twist the blades, the natural resilience of the blade material being used to obtain torsional deflection. The two rotors can be lined up parallel to each other fore and aft for stowage purposes.

The HOK-1 is powered by a 600 h.p. Pratt & Whitney R-1340-48 radial engine which is mounted at the rear end of the fuselage at an angle of 35° from the horizontal to give direct drive to the dual rotor gear-box in the roof. The engine is fan-cooled with the shutter-controlled main air inlet between the rotor pylons. Large rear fuselage doors give complete access to the power-plant. Maximum fuel capacity is 100 U.S. gallons (378 litres).

Details of a new type of landing gear developed for the HOK were announced in May, 1956. Known as "bear-paws," they consist of small skis which are able to prevent the helicopter sinking into soft surfaces and so permit operation from snow, sand or mud. A float landing gear is also available.

The following versions of the Model 600 have been announced :—

HOK-1. Standard production version, first accepted for service with the U.S. Navy on April 28, 1953. In production for U.S. Marine Corps.

HUK-1. Similar to HOK-1. In production for U.S. Navy.

H-43A. Development of HOK-1 for local crash rescue duties with the U.S.A.F., carrying pilot, rescue crew of three and fire-fighting equipment. In production.

H-43B. Crash rescue helicopter for U.S.A.F. Similar to H-43A, but powered by an 825 h.p. Lycoming T53 shaft-turbine. In production. The prototype for this version is an HOK-1 which Kaman modified under contract to the U.S. Air Force through the Lycoming Division of AVCO, as a test-bed for the first flight tests of the Lycoming XT53. This aircraft made its first flight on September 27, 1956. Because the useable cabin space has been doubled by mounting the turbine above the fuselage, the production version will carry a pilot and either seven passengers, four litters and attendant or the equivalent weight in freight. Top speed will be over 132 m.p.h. (213 km.h.).

K-600. This is the designation of the civil counterpart of the HOK-1, which Kaman was first allowed to offer for commercial use in June, 1956.

K-600-3. Civil counterpart of H-43B.

K-600-4. Designation of development of HOK-3 with Blackburn-Turbomeca Twin Turmo 600 shaft-turbine power-plant. Under evaluation by Canadian Services.

DIMENSIONS.—
Rotor diameter 47 ft. (14.33 m.).
Fuselage length 25 ft. (7.62 m.).
Height to tip of highest blade 15 ft. 6½ in. (4.73 m.).



The Kaman H-43A Crash-rescue Helicopter with fire-extinguisher carried externally.

WEIGHTS (K-600).—
Weight empty 4,040 lb. (1,833 kg.).
Normal weight loaded 5,800 lb. (2,631 kg.).
Max. weight loaded 6,800 lb. (3,084 kg.).
WEIGHTS (K-600-4).—
Weight empty 3,955 lb. (1,794 kg.).
Weight loaded (2 seats) 5,755 lb. (2,610 kg.).
Weight loaded (5 seats) 6,295 lb. (2,855 kg.).
Weight loaded (with 3,900 lb.=1,360 kg. freight) 7,725 lb. (3,504 kg.).
PERFORMANCE (K-600, at 5,800 lb.=2,631 kg. A.U.W.).—
Max. speed at 8,000 ft. (2,440 m.) 109 m.p.h. (176 km.h.).
Max. speed at S/L. 104 m.p.h. (167 km.h.).
Cruising speed (max. range) 75 m.p.h. (120 km.h.).
Cruising speed (max. endurance) 58 m.p.h. (93 km.h.).
Max. rate of climb 1,300 ft./min. (400 m./min.).
Vertical rate of climb 800 ft./min. (245 m./min.).
Service ceiling 18,000 ft. (5,500 m.).
Hovering ceiling with ground effect 12,000 ft. (3,660 m.).
Hovering ceiling out of ground effect 9,000 ft. (2,750 m.).
Range 220 miles (354 km.).
Endurance 3 hr. 20 min.
PERFORMANCE (K-600-4, at 6,295 lb.=2,855 kg. A.U.W.).—
Max. speed at S/L 114 m.p.h. (184 km.h.).
Max. speed at 6,000 ft. (1,830 m.) 119 m.p.h. (191 km.h.).
Vertical rate of climb at S/L 1,360 ft./min. (415 m./min.).



The Kaman K-600, the civil version of the HOK-1 Helicopter.

Max. rate of climb at S/L 1,670 ft./min. (510 m./min.).
Absolute hovering ceiling 15,200 ft. (4,630 m.).
Service ceiling 20,600 ft. (6,280 m.).
Range at 105 m.p.h. (169 km.h.) 198 miles (319 km.).
Endurance at 50 m.p.h. (82 km.h.) 2 hr. 20 min.

KELLETT

THE KELLETT AIRCRAFT CORPORATION.

HEAD OFFICE AND WORKS: P.O. Box 35, WILLOW GROVE, PENNSYLVANIA.

President: J. T. Duffy, Jr.

Vice-President: I. Medgebow.

Chief Engineer: C. E. Schneck.

Director of Research: Leonard Goland.

Plant Manager: R. Phillips.

Treasurer and Controller: J. N. Brown.

Secretary: G. P. Williams III.

The Kellett Aircraft Corporation was founded in 1929, and has since been engaged in the development of rotary-wing aircraft.

Kellett moved into a new plant at Willow Grove, Pennsylvania, in November, 1956. The new plant houses all the company's activities under one roof and provides modern accommodation for engineering, manufacturing and flight test operations.

The Company is currently working on eight research and development projects in conjunction with the Armed Services. The projects deal primarily with the many aspects of the VTOL aircraft and the Kellett gyro stabilizing system as applied to service type aircraft.

The only project of which details are available is the K-25 tilting-rotor convertiplane. The design study drawing for this shows a conventional high-wing monoplane configuration with a 32 ft. 6 in. (9.90 m.) diameter four-blade rotor-airscrew at each wing-tip, driven by a single Lycoming XT53-L-1 shaft-turbine engine.

The Company continues to be engaged in sub-contract work on components for aircraft companies throughout the United States.

LARSON

LARSON AERO DEVELOPMENT.

HEAD OFFICE AND WORKS: BUCHANAN FIELD, CONCORD, CALIFORNIA.

Larson Aero Development has produced the prototype of an easy-to-maintain agricultural aircraft for spraying duties. Designated the Larson D-1, it made its first flight on March 30, 1955.

The company is also developing a small single-seat biplane which it intends to market either as ready to fly or in the form of a semi-completed kit. Plans for home construction will also be available. Brief details of this aircraft, which is known as the F-12 Baby Biplane, are given hereafter.

THE LARSON D-1.

TYPE.—Single-seat Agricultural Biplane.
WINGS.—All-metal strut-braced biplane. Wing section Goettingen 365 (modified). Aspect ratio 6. Chord 60 in. (1.52 m.). Dihedral 0° on top wing, 1° on lower wing. No incidence. Aluminium structure and skin. Ailerons are also of aluminium. No flaps are fitted. Aileron area 28 sq. ft. (2.60 m.²). Wing area 315 sq. ft. (29.3 m.²).
FUSELAGE.—Steel-tube structure, with centre portion only fabric-covered.
TAIL UNIT.—Fabric-covered strut-braced steel tube structure, with twin rudders. Areas: rudders 15 sq. ft. (1.39 m.²), elevators 25 sq. ft. (2.32 m.²), tailplane 18 sq. ft. (1.67 m.²). Tailplane span 12 ft. (3.66 m.).
LANDING GEAR.—Fixed tail-wheel type, with Larson spring and oil main struts and bi-lateral spring tail suspension. Ford automobile wheels. Ford automobile brakes with Larson master cylinders. Wheel track 8 ft. (2.44 m.). Wheelbase 21 ft. 6 in. (6.55 m.).
POWER PLANT.—One 225 h.p. Lycoming R-680 nine-cylinder air-cooled radial engine, or 220 h.p. Continental R-670 seven-cylinder air-cooled radial engine, or 245 h.p. Jacobs R-755 seven-cylinder air-cooled radial engine. McCauley ground-adjustable air-screw with steel blades. One 30 U.S. gallon (114 litre) fuel tank in fuselage. Oil capacity 4.4 U.S. gallons (16.6 litres).
ACCOMMODATION.—Pilot only, in high-set open cockpit.
DIMENSIONS.—
Span 33 ft. (10 m.).
Length 27 ft. (8.23 m.).
Height 11 ft. (3.35 m.).
WEIGHTS.—
Weight empty 1,900 lb. (862 kg.).
Weight loaded 3,600 lb. (1,633 kg.).
PERFORMANCE (Lycoming R-680 engine).—
Cruising speed at S/L. 90 m.p.h. (145 km.h.).
Landing speed 40 m.p.h. (64 km.h.).
Rate of climb at S/L. (empty) 1,400 ft./min. (425 m./min.).
Take-off run, empty, no wind, under 200 ft. (60 m.).
Take-off run with 1,000 lb. (454 kg.) payload, no wind, 600 ft. (183 m.).



The Larson D-1 Agricultural Biplane (225 h.p. Lycoming R-680 engine).

THE LARSON F-12 BABY.

TYPE.—Single-seat light biplane.
WINGS.—Single-bay staggered biplane. NACA 4412 (modified) wing section. Aspect ratio approximately 7 for upper wing, 6 for lower wing. Dihedral 1° upper wing, 3° lower wing. Incidence 2°. Conventional two-spar wood structure covered with fabric. Inset ailerons on upper and lower wings have aluminium frames and fabric covering. Total aileron area approximately 6.5 sq. ft. (0.60 m.²). Gross wing area 73 sq. ft. (6.78 m.²).
FUSELAGE.—Welded steel tube framework covered with fabric.
TAIL UNIT.—Welded steel tube framework covered with fabric.
LANDING GEAR.—Tail-wheel type. Main legs sprung within fuselage by rubber cord. Larson cast aluminium wheels and Larson external-expanding brakes. Sprung tail-wheel. Wheel track: 4 ft. 10 in. (1.46 m.).
POWER PLANT.—One 85 h.p. Continental C85 four-cylinder air-cooled engine. McCauley aluminium fixed-pitch airscrew. Fuel tank (12 U.S. gallons=45.4 litres) in fuselage forward of cockpit.
ACCOMMODATION.—Single open cockpit.

DIMENSIONS.—
Span 17 ft. (5.18 m.).
Length 17 ft. (5.18 m.).
Height 5 ft. 6 in. (1.67 m.).

WEIGHTS (estimated).—
Weight empty 500 lb. (227 kg.).
Weight loaded 800 lb. (363 kg.).

PERFORMANCE (estimated).—
Max. speed 130 m.p.h. (208 km.h.).
Cruising speed 110 m.p.h. (176 km.h.).
Initial rate of climb 2,000 ft./min. (610 m./min.).

LEARSTAR



The Learstar Mk. I Executive Transport (two 1,425 h.p. Wright R-1820 engines).

PACAERO ENGINEERING CORPORATION.

OFFICE and WORKS: 3021 AIRPORT AVENUE, SANTA MONICA, CALIFORNIA.

PacAero Engineering Corporation is a subsidiary of Pacific Airmotive Corporation and was formed in 1957 to continue the manufacture of the Learstar executive transport. PacAero occupies facilities covering 240,000 square feet on Santa Monica airport where, in addition to the production of the Learstar, it provides complete repair and maintenance service for Learstar and Lodestar owners, and undertakes the overhaul, modification and re-manufacture of all types of single and multi-engined aircraft, the manufacture of ground support equipment, etc.

The Learstar was originally evolved by the Aircraft Engineering Division of Lear, Inc. in 1953 as a high-speed long-range custom-equipped executive transport specifically for use by business firms and individuals. It is built around certain basic components of the Lockheed Model 18-56 Lodestar. All such components are, however, extensively modified, all operating systems of the aircraft are of entirely new design and construction, and the performance of the aircraft far exceeds that of the Lodestar.

The first prototype Learstar made its initial flight May 19, 1954, and the first production aircraft flew on October 19, 1954. In January, 1955, the Learstar Mk. 1 was certificated by the C.A.A. in the Airline Transport Category, and the first delivery was made on February 26, 1955. The first Mk. II version was granted a supplemental Type Certificate in July, 1956.

THE LEARSTAR MARK I.

TYPE.—Twin-engined Executive Transport.

WINGS.—Low-wing cantilever monoplane. NACA 2300 Series (modified) wing section. Aspect ratio 7.79. Chord 13 ft. 9.3 in. (4.19 m.) at root, 4 ft. 0.8 in. (1.22 m.) at tip. Dihedral 6° 15′ at chord line. Incidence 2°. Aluminium-alloy flush-riveted structure. All-metal ailerons with trim and balance tabs. All-metal Fowler type flaps inboard of ailerons. Total area of ailerons 35 sq. ft. (3.25 m.²). Total area of flaps 107.5 sq. ft. (9.98 m.²). Gross wing area 551 sq. ft. (51.18 m.²).

FUSELAGE.— Aluminium - alloy monocoque structure with flush-riveted skin.

TAIL UNIT.—Cantilever monoplane type with twin fins and rudders. Aluminium-alloy construction. Areas: fins (2) 29.3 sq. ft. (2.72 m.²), rudders (2) 34.8 sq. ft. (3.23 m.²), tailplane 82.6 sq. ft. (7.66 m.²), elevators (total) 40.4 sq. ft. (3.75 m.²). Span of tailplane 23 ft. 2 in. (7.06 m.).

LANDING GEAR.—Retractable or non-retractable, nose-wheel or tail-wheel type, to customer's preference. Cleveland Pneumatic air-oil shock-absorbers. Hydraulic retraction. Goodyear wheels and single-disc spot-type brakes. Track 15 ft. 4 in. (4.67 m.). Wheelbase 35 ft. 3 in. (10.74 m.).

POWER PLANT.—Two Wright Cyclone R-1820-76A nine-cylinder radial air-cooled engines each rated at 1,425 h.p. for T.O. and 1,275 h.p. METO. Hamilton Standard Type 33D50-101/6511-12A airscrews. Fuel in six tanks, two front main (150 U.S. gallons = 567 litres each) and two rear main (172 U.S. gallons = 650 litres each) in centre-section and two outer wing tanks (235 U.S. gallons = 888 litres each). Total internal fuel capacity 1,114 U.S. gallons (4,255 litres). Optional outer wing tanks provide additional 200 gallons (755 litres) of fuel. Oil capacity 38 U.S. gallons (144 litres).

ACCOMMODATION.—Crew of 2 and 8 to 12 passengers. Cabin furnishings and equipment according to customer's requirements. Toilet and galley.

EQUIPMENT.—Weather and ground mapping radar is available as optional equipment. This is housed in a nose radome which fairs perfectly into the aerodynamic contours of the fuselage.

DIMENSIONS.—
Span 66 ft. 2 in. (20.16 m.).
Length 51 ft. (15.55 m.).
Length (with radar nose) 55 ft. 6 in. (16.90 m.).
Height 11 ft. 10 in. (3.60 m.).

WEIGHTS.—
Weight empty approx. 15,000 lb. (6,804 kg.).
Weight loaded 24,000 lb. (10,886 kg.).

PERFORMANCE.—
Max. speed 321 m.p.h. (514 km.h.).
Cruising speed (55% power) at 10,000 ft. (3,050 m.) 280 m.p.h. (448 km.h.).
Stalling speed with flaps 94.2 m.p.h. (151.5 km.h.).
Rate of climb at S/L. 1,494 ft./min. (455 m./min.).
Service ceiling at gross loading 22,950 ft. (6,995 m.).
Single-engine ceiling at gross loading 8,380 ft. (2,555 m.).
Range 3,800 miles (6,080 km.), 4,300 miles (6,920 km.) with optional wing tanks.

THE LEARSTAR MARK II.

The Learstar Mark II conversion is designed primarily for application to extensively-equipped executive Lodestars and does not disturb existing interiors, radio or instrumentation. It includes all the advanced safety features of the Learstar Mark I and virtually all its performance features.

WEIGHTS.—
Take-off weight 22,500 lb. (10,215 kg.).
Landing weight 20,400 lb. (9,261 kg.).

PERFORMANCE.—
Max. cruising speed 290 m.p.h. (464 km.h.) at 10,000 ft. (3,050 m.).
Normal cruising speed 270 m.p.h. (432 km.h.) at 10,000 ft. (3,050 m.).
Range at normal cruising speed 2,500 miles (4,000 km.).

LOCKHEED

LOCKHEED AIRCRAFT CORPORATION.

HEAD OFFICE AND WORKS: BURBANK, CALIFORNIA.

OTHER CALIFORNIA DIVISION FACTORIES: MAYWOOD AND PALMDALE, CALIFORNIA.

GEORGIA DIVISION: MARIETTA AND DAWSONVILLE, GA.

MISSILE SYSTEMS DIVISION: VAN NUYS AND SUNNYVALE, CALIFORNIA.

Incorporated: 1932.

Chairman of Board and Chief Executive: Robert E. Gross.

President: Courtlandt S. Gross.

Executive Vice-President: Daniel J. Haughton.

Senior Vice-President: Cyril Chappellet.

Senior Vice-President: Hall L. Hibbard.

Senior Vice-President: C. A. Barker, Jr.

Vice-President and General Manager, California Division: Burt C. Monesmith.

Vice-President and General Manager, Georgia Division: A. Carl Kotchian.

Vice-President and General Manager, Missile Systems Division: Eugene Root.

Vice-President, Engineering and Research: C. L. Johnson.

Vice-President, Administration: Don Cameron.

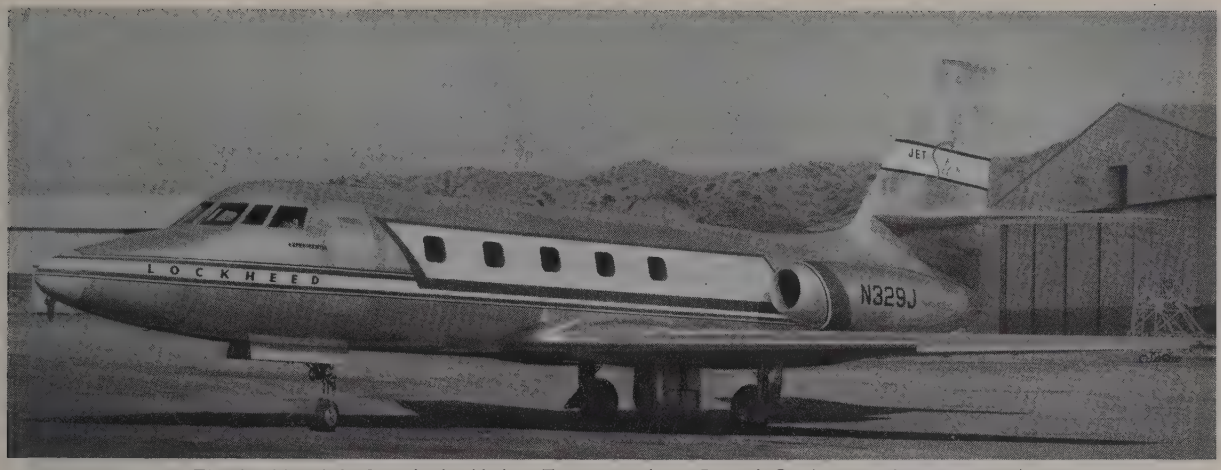
Vice-President, Finance and Comptroller: Dudley E. Browne.

Treasurer: Frank L. Frain.

The original Lockheed Aircraft Co. dates from 1916 when the brothers Allen and Malcolm Loughead, the founders, began with what was the forerunner of the true streamline aeroplane. The factory was moved to Burbank, Cal., the present site, in 1926, and the name changed to Lockheed.

On November 30, 1943, the Vega Aircraft Corporation, which had been formed in 1937 as an affiliate and in 1941 became a wholly-owned subsidiary of the Lockheed Aircraft Corpn., was absorbed and the name Vega abandoned.

The company now employs 48,530 persons, including about 13,000 at its Marietta, Ga., division, which occupies



The Lockheed JetStar Light Utility Transport (two Bristol Orpheus turbojet engines).

a World War II government-owned plant.

By the time Lockheed had celebrated its 25th anniversary in 1957 it had built nearly 30,000 aircraft of seventy different types.

Lockheed's current production includes the single-seat F-104A and two-seat F-104B air superiority fighters for the U.S.A.F., the T-33A jet trainer for the U.S.A.F. (and numerous N.A.T.O. countries); the TV-2 and T2V-1 jet trainers for the U.S. Navy; the P2V Neptune for the U.S. Navy; the WV-2 and RC-121 radar warning aircraft for the U.S. Navy and U.S.A.F. respectively; the WV-3 weather reconnaissance version for the U.S. Navy; the U-2 high-altitude research aircraft; the Super Constellation in passenger and cargo versions for airlines and the military services; the turboprop-powered Electra 188 for airlines; an anti-submarine version of the Electra for the U.S. Navy; and the C-130 turboprop-powered medium cargo transport for the U.S.A.F., U.S. Coast Guard and R.A.A.F.

In addition, the company has built a new ten-passenger twin-jet transport aircraft named the JetStar for civil and military use, the prototype of which flew for the first time on September 4, 1957.

A total of more than 900 Constellation series aircraft, both military and civil have been built or are on order. In 1957 commercial Super Constellations were still coming off the production lines steadily, while military orders in hand extended through 1958.

Considerable research work in advanced flight fields is under way, and it was announced in the Spring of 1956 that many millions of dollars are to be spent on facilities and equipment to adapt the Georgia Division for work connected with the development of nuclear-powered aircraft. In conjunction with the U.S. A.F., a nuclear aircraft testing and research facility was completed in 1958 on a 10,000-acre tract near Dawsonville, Ga., where some 300 scientists, engineers and technicians will work.

The work at Dawsonville is carried on by a new branch of the company, known as the Georgia Nuclear Laboratories, which is also designing reactors for general industrial use.

The Missile Systems Division, formed in November, 1953, is extending its activities to Sunnyvale and Palo Alto, California, while retaining its original Van Nuys plant.

Among the facilities of the Missile Systems Division is a newly-opened laboratory in Stanford University's "industrial park", where experimental nuclear reactor components will be assembled for tests under simulated operating conditions.

Current products of the Missile Systems Division include the X-7 and X-17 test vehicles which are described in the "Guided Missiles" section of this work, and the Q-5 target drone.

Lockheed has also announced that it is working on a very large earth satellite with a recoverable capsule.

THE LOCKHEED JETSTAR.

First announced in March, 1957, and built as a private venture, the prototype of the JetStar flew on September 4, 1957, only 241 days after its basic design was finalised. It is a jet-powered utility transport of conventional all-metal low-wing monoplane design, with normal accommodation for a crew of two and ten passengers.

The two prototype JetStars are each powered by two Bristol Orpheus turbojets, mounted on each side of the rear fuselage, but production models can have as an alternative four lower-powered General Electric J85 or Fairchild J83 turbojets mounted in lateral pairs in the same position. The JetStar will thus meet the requirements of the U.S.A.F.'s UC/X specification for a four-jet aircraft for transport, crew-readiness training and other duties, in addition to its civil applications.

It is also being offered with special equipment for navigator/bombardier training, electronic countermeasures training, fighter interceptor training, target towing, air photography and mapping, and airways and air communications duties.

The following details apply specifically to the version with two Bristol Orpheus turbojets :—

TYPE.—Twin-jet utility transport.

WINGS.—Cantilever monoplane type. Aspect ratio 5.5. Sweepback 34°. All-metal structure. Hydraulically-powered ailerons. "Blown" flaps. Full-span automatic leading-edge slats. Wing area 523 sq. ft. (48.6 m.²).



The Lockheed C-130A Hercules Transport (four Allison T56 turboprop engines).



One of two Lockheed C-130A Transports loaned to the U.S. Marine Corps for in-flight refuelling tests. *(Clay Janssen).*

FUSELAGE. — All-metal semi-monocoque structure. Hydraulically-operated air-brake under rear fuselage.

TAIL UNIT.—Cantilever monoplane type. Fin and high-set all-moving tail are built in one piece and move together. Area of horizontal surfaces 149 sq. ft. (13.84 m.²). Area of vertical surfaces 110 sq. ft. (10.22 m.²). Tailplane span 24 ft. 9 in. (7.55 m.).

LANDING GEAR.—Retractable tricycle type. Hydraulic retraction. Single wheel on all units. Main wheels 30 × 7.7 Type VII. Nose-wheel 18 × 5.5 Type VII. Wheel track 10 ft. 9 in. (3.28 m.). Wheelbase 20 ft. 9 in. (6.33 m.).

POWER PLANT.—Two Bristol Orpheus turbojets (each 4,850 lb. = 2,200 kg. s.t.) mounted on sides of rear fuselage. Fuel in integral wing tanks with total capacity of 1,640 U.S. gallons (6,205 litres). Provision for carrying two 300 U.S. gallon (1,135 litres) or 640 U.S. gallon (2,423 litres) external slipper tanks on wings.

ACCOMMODATION.—Normal accommodation for crew of two and ten passengers, with wardrobe, galley and toilet aft of cabin and baggage compartments fore and aft. Alternative high-density seating for 22 passengers, with toilet and reduced baggage space. Cabin is 28 ft. (8.53 m.) long and 6 ft. 2 in. (1.88 m.) high at the aisle. Cabin is pressurised to the equivalent of 8,000 ft. (2,440 m.) altitude at 45,000 ft. (13,700 m.).

DIMENSIONS.—
Span 53 ft. 8¼ in. (16.36 m.).
Length 58 ft. 9½ in. (17.92 m.).
Height 20 ft. 6 in. (6.25 m.).

WEIGHTS (Standard version).—
Weight empty 15,290 lb. (6,936 kg.).
Weight loaded 28,870 lb. (13,096 kg.).

WEIGHTS (Long-range version).—
Weight empty 16,130 lb. (7,316 kg.).
Weight loaded 38,030 lb. (17,250 kg.).

PERFORMANCE (Standard version).—
Max. speed 613 m.p.h. (986 km.h.).
Economical cruising speed 510 m.p.h. (820 km.h.).
Stalling speed at 26,000 lb. (11,793 kg.) A.U.W. 106 m.p.h. (170 km.h.).
Rate of climb at S/L 6,400 ft./min. (1,950 m./min.).
Absolute ceiling 49,000 ft. (14,935 m.).
Range 1,785 miles (2,870 km.).

PERFORMANCE (Long-range version).—
Max. speed 595 m.p.h. (958 km.h.).
Economical cruising speed 483 m.p.h. (777 km.h.).
Stalling speed at 26,000 lb. (11,793 kg.) A.U.W. 106 m.p.h. (170 km.h.).
Rate of climb at S/L 4,200 ft./min. (1,280 m./min.).
Absolute ceiling 41,000 ft. (12,500 m.).
Range 3,280 miles (5,278 km.).

THE LOCKHEED HERCULES.
U.S.A.F. designation: C-130.

The C-130 is a medium multi-purpose transport for the movement of military personnel and material, and their delivery by landing or parachute as required. It can be converted rapidly into an ambulance for evacuation of wounded on return flights.

Other duties for which it can be specially equipped include high-altitude mapping, weather reconnaissance, search and rescue, forest fire fighting, flight refuelling, ferrying fuel to advance bases and high-altitude drone launching and directing.

Aft of the main hold, the rear fuselage is sharply upswept. In the upswept portion is a built-in loading ramp which serves as the rear door. This ramp can be lowered to truck-bed height for loading stores, or to the ground for wheeled and tracked vehicles to be driven in. The rear door can also be opened in flight for the air dropping of paratroops and equipment. There is also a large cargo-loading door ahead of the wings.

The retractable tricycle landing gear, with the main wheels in tandem, is designed to permit the C-130 to operate from small emergency landing fields or rough forward airstrips. There is provision for eight 1,000 lb. (455 kg.) thrust JATO units in the main landing gear fairings.

The C-130 was designed to a specification issued by the U.S.A.F. Tactical Air Command in 1951, and Lockheed were awarded a production contract on Sept-1952. The following versions have been announced :—

YC-130. The first prototype under this designation flew on August 23, 1954.

C-130A. Initial production version with four 3,750 h.p. Allison T56-A-1 turboprops. First flown on April 7, 1955. Deliveries of this version to U.S.A.F. began in December, 1956. Contracts for 231 aircraft, last to be delivered in February, 1959. Two C-130A's are being modified into "universal drone launchers." Twelve C-130A's have been ordered for Royal Australian Air Force.



A Lockheed C-130A Hercules Transport equipped with a combination wheel/ski landing gear.



The Lockheed C-130B Hercules (four 4,050 e.s.h.p. Allison T56-A-7A engines and 13 ft. 6 in. diameter paddle-blade airscrews).

RC-130A. Reconnaissance version of C-130A with new photo-mapping equipment. Present contract is for 16 aircraft, including prototype.

C-130B. Developed version with additional 1,650 U.S. gallons (6,246 litres) of fuel in wings inboard of inner engine nacelles, strengthened landing gear and four 4,050 h.p. Allison T56-A-7A turboprops, driving four-blade Hamilton Standard Type 54H60 airscrews, 13 ft. 6 in. (4.11 m.) diameter. Oil capacity 48 U.S. gallons (182 litres). In production for U.S.A.F.

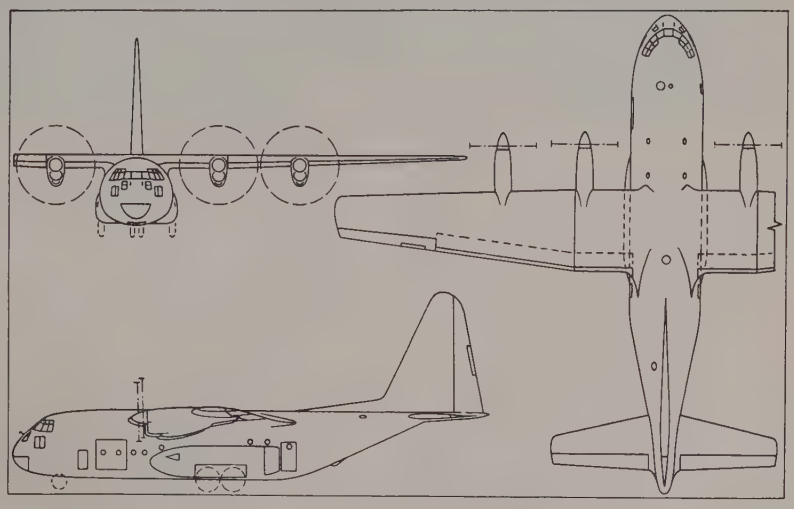
SC-130B. Four for the U.S. Coast Guard for delivery in 1959-1960. To be used for search, rescue and other duties. Modifications include addition of radio operator's station in flight compartment, accommodation for "on scene" commander and two search observer seats and clear-vision panel in rear paratroop door for low-level search.

GV-1. Two for U.S. Marine Corps for delivery in 1960. Assault transport. Can be equipped for in-flight refuelling to service two jet aircraft simultaneously. Entire refuelling equipment can be quickly and easily installed and removed. Two C-130A's loaned to U.S.M.C. in the Summer of 1957 for flight refuelling tests. The production tanker version will have a tankage capacity of 6,000 U.S. gallons (22,730 litres) in its cargo compartment.

Lockheed have applied to the C.A.A. for certification of a commercial version of this design under the company designation Model GL-108.

A test version of the C-130A equipped with a combination wheel-ski landing gear flew for the first time on January 29, 1957, and took off successfully from the frozen Red Lake, Minnesota, at an A.U.W. of 124,000 lb. (56,245 kg.) early in 1958.

The following description refers to the C-130A.



The Lockheed C-130A Hercules Medium Assault Transport.

TYPE.—Medium Combat Transport.

WINGS.—Cantilever high-wing monoplane. Aspect ratio 10. Dihedral 2½°. Mean chord 13 ft. 8½ in. (4.16 m.). All-metal two-spar structure, with integrally-stiffened tapered machined skin panels up to 48 ft. (14.63 m.) long. Thermal de-icing on leading-edge. Gross wing area 1,745 sq. ft. (162.12 m.²).

FUSELAGE. — All - metal semi - monocoque structure.

TAIL UNIT.—Cantilever monoplane type. Thermal de-icing on tailplane leading-edge.

LANDING GEAR.—Retractable nose-wheel type. Hydraulic retraction. Each main wheel unit has two tandem wheels which retract into fairings built onto the sides of the fuselage. Nose unit has twin wheels and is steerable through 60° each side of centre. Wheel track 14 ft. 3 in. (4.35 m.). Special retractable combination wheel-skis available for arctic operation. Each main ski is 19 ft. 6 in. long by 5 ft. 6 in. wide (5.94 × 1.68 m.) and weighs 1,700 lb. (770 kg.). The nose ski measures 9 ft. 6 in. in length and 5 ft. 6 in. wide (2.90 × 1.68 m.). All three are sprung to provide 18 in. (0.46 m.) of upward and downward pitch at either end and have a bearing surface of Teflon plastic to reduce friction and resist the adhesiveness of ice.

POWER PLANT.—Four 3,750 e.s.h.p. Allison T56-A-1A turboprop engines in armoured nacelles. Aeroproducts three-blade constant-speed fully-feathering reversible-pitch airscrews, 15 ft. (4.6 m.) diameter. Eight Aerojet-General 15 KS-1000 JATO units (8 × 1,000 lb.=455 kg. thrust for 15 seconds) can be carried in the main landing gear fairings. Single-point pressure refuelling. Fuel in four main tanks, two in each wing, with a total capacity of 5,250 U.S. gallons (19,865 litres). Oil capacity 32 U.S. gallons (121 litres).

ACCOMMODATION.—Pressurised accommodation for crew of four, comprising pilot, co-pilot, navigator and "systems manager". Maximum pressure differential 7½ lb./sq. in. (0.53 kg./cm.²). Pilot and co-pilot have armour protection against small arms fire. Flight deck and cabin air-conditioned in flight and on the ground. Power-assisted controls. Cargo compartment, also pressurised, is 41 ft. 5 in. long, 10 ft. wide and 9 ft. 1 in. high (12.6 m.×3.05 m.×2.3 m.), with a maximum capacity of 4,300 cub. ft. (121.7 m.³) and normal usable capacity of 3,680-3,850 cub. ft. (104.2-109 m.³). All doors are 3 ft. 5 in. (1.03 m.) from the ground. Hydraulically-operated main loading door is 10 ft.×9 ft. (3.05 m.×2.74 m.); side cargo door is 7 ft. 2½ in.×6 ft. (2.19 m.×1.83 m.); paratroop door is 3 ft. ×6 ft. (0.91 m.×1.83 m.). Standard complements are as follows: Troops (max.) 92, Paratroops (max.) 64, Litters 74 and 2 attendants, Passengers 55, with provision for forward or rearward-facing seat. As a cargo carrier, loads can include heavy equipment such as a 26,640 lb. (12,080 kg.) Type F.6 refuelling trailer or a 155 mm. howitzer and its high-speed tractor. Up to six pre-loaded pallets of freight can be loaded direct. As a missile carrier can accommodate 3 × Honest John; 2 Nike-Hercules plus boosters; 2 × Corporal; 2 × Sergeant; 1 × Bomarc or 1 × Matador with, in most cases, related handling and launching equipment.

DIMENSIONS.—
Span 132 ft. 7 in. (40.25 m.).
Length 97 ft. 8 in. (29.78 m.).
Height 38 ft. (11.58 m.).

WEIGHTS (C-130A).—
Weight empty (normal) 59,800 lb. (27,125 kg.).
Weight empty (max.) 63,800 lb. (28,940 kg.).
Design A.U.W. (normal) 108,000 lb. (48,988 kg.).
Design A.U.W. (overload) 124,200 lb. (56,340 kg.).
Landing weight (normal) 96,000 lb. (43,540 kg.).
Landing weight (max.) 124,200 lb. (56,340 kg.).

WEIGHTS (C-130B).—
Weight empty (equipped) 69,300 lb. (31,460 kg.).
Max. loaded weight 140,250 lb. (63,616 kg.).
Max. landing weight 135,000 lb. (61,235 kg.).

PERFORMANCE (C-130A).—
Max. speed over 370 m.p.h. (595 km.h.).
Max. cruising speed 360 m.p.h. (580 km.h.).
Rate of climb at S/L at 120,000 lb. (54,430 kg.) A.U.W. 2,400 ft./min. (730 m./min.).
Service ceiling 40,000 ft. (12,190 m.).
Take-off distance to 50 ft. (15.25 m.) at 120,000 lb. (54,430 kg.) A.U.W. 3,650 ft. (1,112 m.).
Landing distance from 50 ft. (15.25 m.) at 100,000 lb. (45,360 kg.) A.U.W. 1,420 ft. (433 m.).
Range with 38,800 lb. (17,600 kg.) payload at 335 m.p.h. (539 km.h.) 1,950 miles (3,138 km.).
Range with max. fuel and 29,200 lb. (13,245 kg.) payload at 335 m.p.h. (539 km.h.) 2,900 miles (4,667 km.).
Range with max. fuel and 24,600 lb. (11,158 kg.) payload at 330 m.p.h. (531 km.h.) 3,000 miles (4,828 km.).

PERFORMANCE (C-130B).—
Max. cruising speed 370 m.p.h. (595 km.h.).
Rate of climb at S/L 2,450 ft./min. (747 m./min.).
Take-off distance to 50 ft. (15.25 m.) at 135,000 lb. (61,235 kg.) A.U.W. 4,200 ft. (1,280 m.).



One of two prototypes of the Lockheed Electra (four Allison 501 turboprop engines).

Landing distance at 100,000 lb. (45,360 kg.) A.U.W. 1,400 ft. (427 m.).
Range with 36,700 lb. (16,647 kg.) payload at 350 m.p.h. (563 km.h.) 2,450 miles (3,940 km.).
Range with 25,000 lb. (11,340 kg.) payload at 350 m.p.h. (563 km.h.) 3,570 miles (5,745 km.).
Range with max. fuel and 22,700 lb. (10,297 kg.) payload at 350 m.p.h. (563 km.h.) 4,000 miles (6,437 km.).

THE LOCKHEED 188A ELECTRA.

U.S. Navy designation: P3V-1.

The Electra is a short medium-range airliner which is powered initially by four 3,750 e.s.h.p. Allison Model 501 (military designation T56) turboprop engines, but will be able to take engines developing up to 5,500 e.s.h.p. each. The first prototype flew on December 6, 1957, followed by the second prototype on February 13, 1958.

The initial order "off the drawing board" for 35 Electras was received from American Airlines in 1955 and actual construction of these aircraft began in October, 1956. Delivery will begin in the latter part of 1958 and all 35 are due to be delivered by the middle of 1959. Subsequent orders have been placed by the following airlines: Eastern Air Lines 40, with an option on 30 more; National Airlines 23; Braniff International Airways 9; K.L.M. 12; Western Air Lines 9; Cathay Pacific Airways 2; Pacific Southwest Airliner 3; Garuda Indonesian Airways 3; Ansett Australian National Airways 2; Aeronaves de Mexico 3; Qantas 4; Tasman Empire Airways 3; Trans-Australia Airlines 2.

In addition it was announced in April 1958 that the U.S. Navy has ordered an anti-submarine version of the Electra as a replacement for the P2V Neptune. Basically similar to the standard airliner, this version will carry a crew of ten and will be fitted with extensive equipment to detect and destroy submarines. A prototype first flew on August 19, 1958. The production version will be designated P3V-1.

TYPE.—Four-engined Medium-range Airliner.

WINGS.—Cantilever low-wing monoplane. Wing section NACA 0014-1.10 at root, NACA 0012-1.10 at tip. Aspect ratio 7.5. Chord 18 ft. 11 in. (5.77 m.) at root, 7 ft. 7 in. (2.31 m.) at tip. Dihedral 6°. Incidence 3° at root, $\frac{1}{2}$° at tip. Extruded and integrally-stiffened aluminium-alloy box beam structure. Conventional aluminium-alloy ailerons and high lift Fowler type flaps. Total aileron area 98 sq. ft. (9.10 m.²). Total flap area 208 sq. ft. (19.32 m.²). Gross wing area 1,300 sq. ft. (120.77 m.²).

FUSELAGE. — Aluminium-alloy semi-monocoque structure.

TAIL UNIT.—Aluminium-alloy cantilever monoplane type. Areas: fin 165 sq. ft. (15.33 m.²), rudder 47 sq. ft. (4.37 m.²), elevators 79 sq. ft. (7.34 m.²), tailplane 320 sq. ft. (29.73 m.²). Tailplane span 42 ft. 10 in. (13.06 m.).

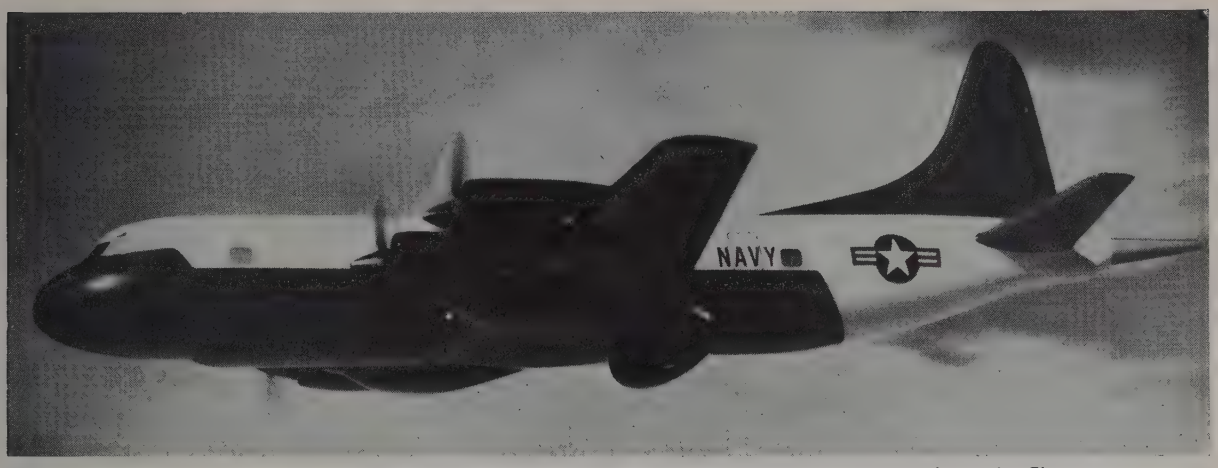
LANDING GEAR.—Retractable tricycle type. Menasco oleo-pneumatic shock-absorbers. Hydraulic retraction. Each main unit has twin wheels with 13.50-16 tyres, pressure 138 lb./sq. in. (9.70 kg./cm.²). Steerable nose-wheel unit has twin wheels with 7.50-14 tyres. Wheel track 31 ft. 2 in. (950 m.). Wheelbase 37 ft. (11.28 m.).

POWER PLANT.—Four 3,750 e.s.h.p. Allison 501-D13A (later 4,050 e.s.h.p. Allison 501-D15) turboprop engines, giving 2,060 e.s.h.p. per engine for cruising at 20,000 ft. (6,100 m.). Aeroproducts or Hamilton Standard Type 54H60 four-blade reversible-pitch airscrews, 13 ft. 6 in. (4.11 m.). diameter. Total fuel capacity 5,360 U.S. gallons (20,210 litres), in two 1,090 U.S. gallon (4,127 litre) inboard wing tanks and two 1,590 U.S. gallon (6,018 litre) outboard wing tanks. Single-point fuelling, with underwing fuelling panel at bottom rear of No. 3 nacelle. Oil capacity 24 U.S. gallons (91 litres).

ACCOMMODATION.—Pressurised cabin for crew of five and passengers maintains 8,000 ft. (2,440 m.) cabin atmosphere at 30,000 ft. (9,150 m.). Internal diameter of cabin 10 ft. 8 in. (3.25 m.). Initial version for American Airlines will have accommodation for 81 passengers including 6 in a special lounge; but a high-density version with seats for 85 passengers and a 6-seat lounge will also be available. In international configuration, seating can be 44 (siesta arrangement), 65 (mixed custom and



The first Lockheed Electra for Eastern Air Lines, the first U.S. domestic carrier to put the Electra into service.



An impression of the Lockheed P3V-1, a Naval Patrol and ASW aircraft developed from the Electra.

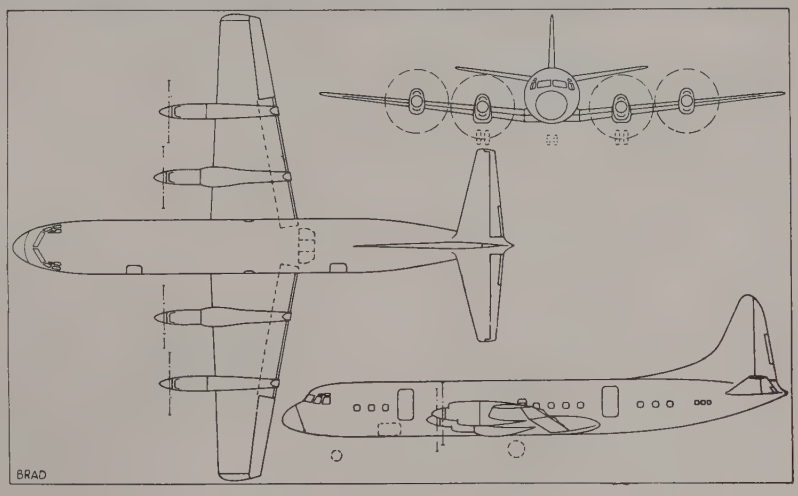
standard), 66 (custom) or 88 (standard). The international version will have four toilets instead of the normal two. Integral passenger loading steps will fold into the fuselage wall when not in use. Main cabin floor area 707 sq. ft. (65.68 m.²). Main cabin luggage space 119 cub. ft. (3.37 m.³). Lower compartment cargo space 511 cub. ft. (14.47 m.³). All versions will carry up to 4,000 lb. (1,816 kg.) of air freight, express and mail, in addition to the normal amount of passengers' baggage.

EQUIPMENT.—Standard equipment will include autopilot and weather-avoidance radar.

DIMENSIONS.—
Span 99 ft. (30.18 m.).
Length 104 ft. 6½ in. (31.81 m.).
Height 32 ft. 1 in. (9.78 m.).

WEIGHTS.—
Weight empty (domestic) 56,000 lb. (25,401 kg.).
Weight empty (international) 57,000 lb. (25,855 kg.).
Normal payload 21,638 lb. (9,815 kg.).
Max. weight limit payload 26,500 lb. (12,020 kg.).
Gross T.O. weight 113,000 lb. (51,256 kg.).
Max. landing weight 95,650 lb. (43,385 kg.).
Max. zero fuel weight 86,000 lb. (39,010 kg).

PERFORMANCE.—
Max. speed at 12,000 ft. (3,660 m.) 448 m.p.h. (722 km.h.).
Cruising speed at 85,500 lb. (38,782 kg.) A.U.W. at 22,000 ft. (6,700 m.) 405 m.p.h. (652 km.h.).
Stalling speed at 95,650 lb. (43,385 kg.), flaps down, 107 m.p.h. (172 km.h.).
Max. rate of climb at S/L. at 113,000 lb. (51,256 kg.) A.U.W. 1,670 ft./min. (509 m./min.).
Max. rate of climb at S/L. at 92,000 lb. (41,731 kg.) A.U.W. 2,400 ft./min. (731 m./min.).
Service ceiling at 100,000 lb. (45,359 kg.) A.U.W. 27,000 ft. (8,230 m.).



The Lockheed Electra Airliner.

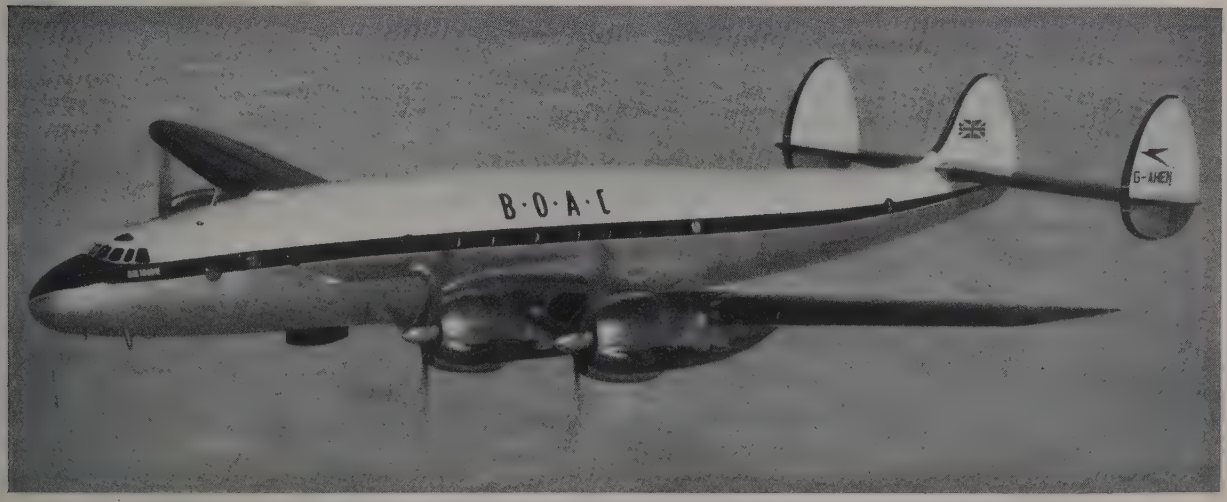
CAA take-off runway at 113,000 lb. (51,256 kg.) A.U.W. 5,820 ft. (1,775 m.).
CAA take-off runway at 106,700 lb. (48,217 kg.) A.U.W. 5,250 ft. (1,600 m.).
CAA landing runway at 85,500 lb. (38,782 kg.) A.U.W. 4,960 ft. (1,510 m.).
Range at take-off weight of 113,000 lb. (51,256 kg.), with 18,000 lb. (8,165 kg.) payload and 7,100 lb. (3,220 kg.) fuel reserve 2,770 miles (4,458 km.).

THE LOCKHEED CONSTELLATION.
U.S. Air Force designation: C-121.
U.S. Navy designation: WV.

The design of the original Model 49 Constellation was begun in June, 1939, to the requirements of Transcontinental & Western Air, Inc. During its development, and after consultation with T.W.A., Pan American Airways also ordered a number of Constellations but on the entry of the United States into the war both companies waived their rights in favour of the Army Air Forces, to whose requirements the Constellation was completed. The first Constellation to fly on January 9, 1943, was a C-69 military transport. The first Constellation to be built throughout as a commercial aeroplane was completed in 1947.

The following are the various currently-used versions of the civil and military Constellations :—

Model 49. First commercial version.



A Lockheed Model 749 Constellation in the colours of the British Overseas Airways Corporation.



A Lockheed Model 1049C Super Constellation of Pakistan International Airlines.

Built from components of C-69 military Constellations cancelled on VJ-Day and modified for civil airline use. ATC No. 763 granted by C.A.B. on December 11, 1945. Gross take-off weight 96,000 lb. (43,585 kg.). Landing weight 83,000 lb. (37,680 kg.). Total fuel capacity 4,690 U.S. gallons (17,130 litres).

Model 149. This was the Model 49 with the outer wings of the Model 749. Total fuel capacity 5,820 U.S. gallons (22,000 litres). Gross take-off weight 100,000 lb. (45,400 kg.).

Model 649A. First Constellation built throughout as a commercial type. Four Wright Cyclone 749C18BD1 engines, direct fuel-injection. Total fuel capacity 4,690 U.S. gallons (17,130 litres). More luxuriously furnished and has slightly greater maximum and cruising speeds. Gross take-off weight increased to 98,000 lb. (44,490 kg.). Landing weight 89,500 lb. (40,630 kg.). The Speedpak was first used in this model.

Model 749. Long-range version of the 649. Additional fuel tank (565 U.S. gallons = 2,135 litres) in each outer wing, to raise total fuel capacity to 5,820 U.S. gallons (22,000 litres). Range increased by 1,000 miles (1,600 km.) while carrying the same payload as the 649. Gross take-off weight 102,000 lb. (46,310 kg.). Landing weight 84,500 lb. (38,363 kg.).

Model 749A. Max. take-off weight 107,000 lb. (48,580 kg.), permitting use of Speedpak at any load factors up to range of 2,200 miles (4,520 km.). Fuel capacity 5,820 U.S. gallons (22,000 litres). Maximum landing weight 89,500 lb. (40,633 kg.).

C-121A. Military long-range personnel and cargo version of the Model 749.

VC-121B. Military long-range V.V.I.P. transport version of the Model 749.

WV-1. Modified 749 to test advanced electronic systems. Two ordered by U.S. Navy. First flew on June 9, 1949.

Full details of the structure and performance of the Constellation have appeared in earlier editions of "All the World's Aircraft."

THE LOCKHEED 1049 SUPER CONSTELLATION.

U.S. Air Force designation: C-121.
U.S. Navy designations: R7V and WV.

The Super Constellation Model 1049 is basically similar to the Constellation, but with a longer fuselage and other improvements to increase its payload and performance. Details of the various currently-used and production versions, both civil and military, are given hereafter :—

Model 1049. First Super Constellation. Fuselage 18.4 ft. (5.6 m.) longer than that of Constellation. Four 2,800 h.p. Wright Cyclone 956C18 CB1 engines. Fuel capacity 6,550 U.S. gallons (24,760 litres). Gross take-off weight 120,000 lb. (54,480 kg.). Landing weight 98,500 lb. (44,720 kg.). Carries up to 92 passengers. Cruising speed 320 m.p.h. (512 km.h.). Fourteen were delivered to Eastern Air Lines and ten to Trans World Airlines in 1952. First prototype, a conversion of the original C-69 prototype, flew for the first time on October 13, 1950.

Model 1049C. This is the 1049 fitted with four Wright R-3350-DA1 Turbo Compound engines. First to incorporate Lockheed-Dreyfuss interior, the convertibility features of which make possible a 47-seat "siesta" version, a 59-63 passenger luxury version or a 94-seat tourist version. On domestic versions the compartment needed for extra crew on trans-Atlantic flights may be used for passengers so that capacities are slightly higher ; up to 99 in tourist version. Gross take-off weight 133,000 lb. (60,380 kg.). Maximum landing weight 110,000 lb. (49,940 kg.). First Model 1049C flew for first time on February 17, 1953. Model 1049C Super Constellations are in service with the following airlines : Air France 9, Pakistan International 3, Qantas Empire Airways 3, Trans-Canada Air Lines 5, Air-India International 2, Eastern Air Lines 16, K.L.M. 8.

Model 1049D. Commercial cargo transport version of 1049 fitted with four 3,250 h.p. Wright R-3350-DA1 Turbo Compound engines. Has total usable cargo volume of 5,568 cub. ft. (156 m.³) and a capacity for 36,200 lb. (16,435 kg.) of payload. Two large cargo loading doors, aft door 9 ft. $4\frac{1}{2}$ in. × 6 ft. $2\frac{1}{2}$ in. (2.85 m. × 1.89 m.), forward door 5 ft. $1\frac{1}{2}$ in. × 6 ft. $4\frac{3}{4}$ in. (1.56 m. × 1.94 m.). Maximum T.O. weight 135,400 lb. (61,416 kg.) Maximum landing weight 113,000 lb. (51,256 kg.). Four in service with Seaboard & Western Airlines.

Model 1049E. Improved version of 1049C with same maximum take-off weight but with addition of all structural modifications (except to landing gear) to permit increase of maximum take-off



The Lockheed Model 1049G Super Constellation here seen fitted with a radar nose.



The Lockheed C-121C Military Long-range Transport version of the 1049 Super Constellation.

weight to 150,000 lb. (68,100 kg.) when engines of higher power become available. Some Model 1049E's have been modified into 1049E/01's with maximum take-off weight of 135,400 lb. (61,416 kg.), and some to 1049E/02's with this same take-off weight plus an increase in landing weight to 113,000 lb. (51,256 kg.).

In service with the following airlines: K.L.M. 4, Qantas Empire Airways 7, Air-India International 3, Avianca 3, Iberia 3, L.A.V. 1, T.C.A.2, Seaboard and Western 1

Model 1049G. Four 3,250 h.p. Wright R-3350-DA3 Turbo Compound engines. Can be fitted with wing-tip auxiliary tanks (600 U.S. gallons each) raising total maximum fuel capacity to 7,750 U.S. gallons (29,340 litres). Normal range (with reserves) 4,620 miles (7,440 km.), absolute range 5,840 miles (9,400 km.). Maximum gross take-off weight 137,500 lb. (62,425 kg.). Maximum permissible landing weight 113,000 lb. (51,300 kg.).

Model 1049G Super Constellations are in service with the following airlines:— Air France 14, Northwest Airlines 4, Trans World Airlines 28, Deutsche Lufthansa 8, VARIG (Brazil) 5, Transportes Aereos Portugueses 3, Cubana de Aviacion 2, K.L.M. 6, Avianca 1, Linea Aeropostal Venezolana 1, Qantas Empire Airways 2, Trans-Canada Air Lines 2, Air-India International 3, Eastern Air Lines 10. In addition, orders in hand include Thai Airways 3, Cubana 1, L.A.V. 1, Qantas 2, T.C.A. 2, Air-India International 2, Iberia 2.

Model 1049H. Convertible passenger-cargo version of the Model 1049G, with fuselage stressed for heavy loads and new extruded aluminium floor. Designed to carry 40,203 lb. (18,236 kg.) of cargo under 5% overload conditions with a domestic interior, and a normal payload of 35,118 lb. (15,929 kg.). The 83 ft. (25.3 m.) long main cabin and two lower compartments provide 5,569 cub. ft. (157 $m.^3$) of stowage space. Dimensions of the rear cargo double-door are 9 ft. 4½ in. wide by 6 ft. 2½ in. high (2.85 m. × 1.88 m.) and of the forward door 5 ft. 1½ in. wide by 6 ft. 4¾ in. high (1.56 m. × 1.95 m.).

The Standard Model 1049H is so equipped that it can be converted in a few hours into a passenger aircraft with accommodation for up to 109 passengers and a crew of eleven. Quickly-installed fittings include lounge-type chairs, hat-racks, vinyl interior walls, toilets, curtains, reading lights and buffet.

Dimensions and fuel capacity are as for the Model 1049G, but the Model 1049H has Wright R-3350-EA3 engines and an increased maximum take-off weight of 140,000 lb. (63,500 kg.). Normal range with three hours of reserve fuel is 4,313 miles (6,940 km.) in passenger configuration or 3,393 miles (5,459 km.) in cargo configuration.

Model 1049H Super Constellations have been ordered by: The Flying Tiger Line 10, Qantas Empire Airways 2, Seaboard & Western Airlines 5, California Eastern 3, Resort Airlines 2, Air Finance 3, National 4, Dollar Association 1, Pakistan International 2, K.L.M. 1, REAL (Brazil) 4.

There are ten military and naval versions of the 1049 Super Constellation, brief details of which follow:—

C-121C. Military long-range transport version of the Model 1049 with Wright R-3350 Turbo Compound engines. Quickly convertible to carry 75 passengers, 47 litter patients and attendants, or 14 short tons of freight. Take-off weight 135,400 lb. (61,416 kg.).

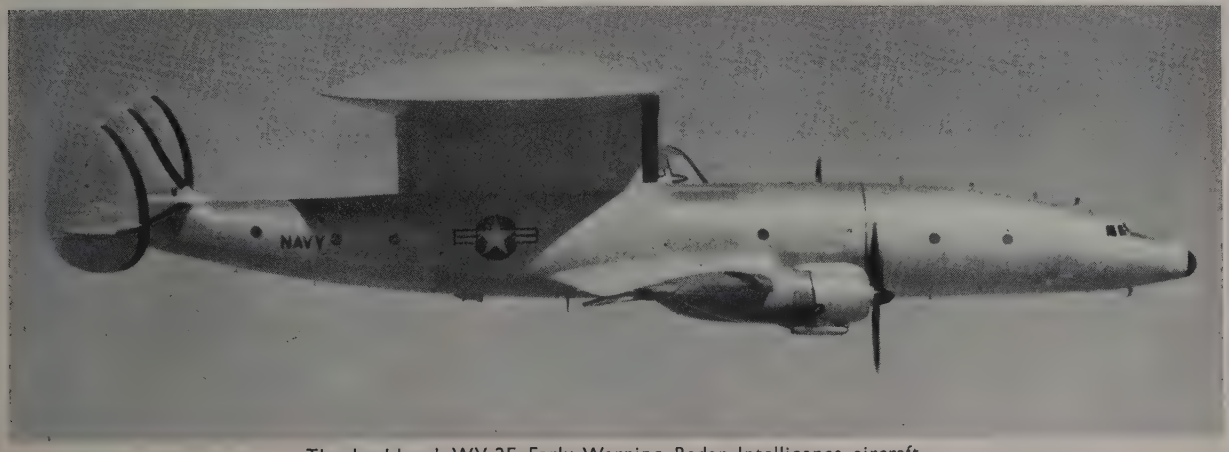
RC-121C. U.S.A.F. version of WV-2 early-warning radar and reconnaissance aircraft. Total fuel capacity 6,550 U.S. gallons. See WV-2 below.

RC-121D. Developed version of RC-121C. Additional fuel in two wing-tip tanks (600 U.S. gallons each) and one fuselage tank (1,000 U.S. gallons). Total fuel capacity 8,750 U.S. gallons, sufficient for endurance of 24 hours.

VC-121E. Specially-equipped C-121C reserved for the use of the President of the United States.

YC-121F. Four 5,700 s.h.p. Pratt & Whitney T34-P-6 turboprop engines with Hamilton Standard three-blade airscrews, 15 ft. (4.57 m.) diameter. Two ordered by U.S.A.F. Similar to Navy R7V-2. Has capacity for 106 passengers, 18 short tons of cargo or 73 stretcher cases. A.U.W. 150,000 lb. (68,100 kg.), landing weight 113,000 lb. (51,300 kg.). Fuel capacity (including tip tanks) 8,770 U.S. gallons (33,150 litres). Cruises at 440 m.p.h. (708 km.h.) and lands at 104 m.p.h. (167 km.h.). Designed range 3,000 miles (4,800 km.), with reserves, carrying 20,000 lb. (9,080 kg.) payload. Absolute range, no reserves, 4,000 miles (6,400 km.). First YC-121F made its first flight on April 5, 1955.

WV-2. After service tests of the WV-1 Constellation, the U.S. Navy ordered into production the WV-2 to serve as a high-altitude reconnaissance and early-warning radar intelligence aircraft, and five orders so far received will extend production into 1958. Developed from Super Constellation and powered by four 3,250 h.p. Wright Turbo Compound engines. Equipped with some five and a half tons of radar and electronics, including G.E. height-finding radar in upper fuselage radome 7 ft. (2.13 m.) high, and G.E. surveillance or distance-measuring radar in the huge under-fuselage radome.



The Lockheed WV-2E Early-Warning Radar Intelligence aircraft.



The Lockheed R7V-1 Naval Transport version of the Model 1049B Super Constellation.

Five radar consoles and plotting tables permit observation of various presentations or segments of the same basic radar picture and work on a variety of search and interception problems. Auxiliary radar units provide specialised presentations. CIC (Combat Information Center) co-ordinates all search information for communication to ships, bases or other aircraft. Navigational equipment includes storm-warning radar, Loran, etc. Equipped with bunks, galley, repair shop and all facilities for long missions. Provision for a crew of up to 31, including relief pilots, radar operators, technicians and maintenance specialists.

WV-2E. This new version of the WV-2 carries a very large radar scanner in a 37 ft. (11.28 m.) wide streamlined disc-shaped housing mounted on a pylon above its fuselage.

WV-3. Weather reconnaissance version of the WV-2, with special electronic equipment. In service with the U.S. Navy.

R7V-1. U.S. Navy transport version of the Model 1049B with four Wright R-3350-34W Turbo Compound engines. Carries up to 106 passengers in backward facing 20G removable seats, up to 19 short tons of cargo, or 73 casualties on stretchers. A.U.W. 133,000 lb. (60,380 kg.). Large loading doors fore and aft of wings.

R7V-2 (formerly R7O-2). Two aircraft powered by four 5,700 s.h.p. Pratt & Whitney T34 turboprop engines for evaluation of this type of power-plant for transport aircraft. Fitted with two 600 U.S. gallon wing-tip tanks, with provision for two additional 500 U.S. gallon underwing tanks, to give a total maximum fuel capacity of 8,770 U.S. gallons (33,150 litres). First R7V-2 flew on September 1, 1954.

The R7V-2 programme was cancelled in 1957 and one of the two aircraft, on bailment to Lockheed from the U.S. Navy, has now been fitted with four Allison 501 turboprop engines for a 1,000-hour flight test programme to speed development of these engines for the Electra.

The following description applies mainly to the civil Model 1049C. The structural description applies generally to all versions of the Super Constellation.

TYPE.—Four-engined Airliner.

WINGS.—Cantilever low-wing monoplane. All-metal structure in seven main sections consisting of centre-section, two inner wings carrying engine nacelles, two outer wings and detachable tips. Two-spar structure with flush-riveted stressed metal skin. All-metal ailerons each have controllable trim-tab and hydraulic boost control. Lockheed-Fowler trailing-edge flaps extend from ailerons nearly to centre-line of fuselage. Gross wing area 1,650 sq. ft. (153.5 m.²).

FUSELAGE. — All-metal semi-monocoque structure. Circular cross-section throughout length and with centre-line cambered for aerodynamic cleanliness.

TAIL UNIT.—Cantilever monoplane type, consisting of tailplane and two-piece elevator mounted at top of fuselage, and two inset fins and rudders with third fin and rudder on fuselage centre-line. All-metal structure with stressed metal skin on fins, tailplane and elevators. Metal-framed fabric-covered rudders. Controllable trim-tabs in rudders and elevators. Hydraulically-boosted control surfaces with manual override control for auxiliary use. Tailplane span 50 ft. 0 in. (15.24 m.).

LANDING GEAR.—Retractable tricycle type with dual wheels on all units. Dual hydraulic brake system on main wheels with manual auxiliary override control. Track (centre-line of legs) 28 ft. 0 in. (8.50 m.).

POWER PLANT.—Four Wright R-3350-DA1 Turbo Compound eighteen-cylinder two-row radial air-cooled engines each rated at 3,250 h.p. for take-off. Stainless-steel nacelles, with all ducting and controls grouped at fire-proof bulkhead, are completely detachable and can be changed in 30 minutes. Automatic fire-detection and location with positive fire-extinguisher system operated by flight engineer. Hamilton Standard or Curtiss three-blade reversible airscrews, 15 ft. 2 in. (4.62 m.) diameter. Seven separate fuel systems in wings with total capacity of 6,550 U.S. gallons (24,760 litres). Total oil capacity 227 U.S. gallons (858 litres) in five separate tanks.

ACCOMMODATION.—Pressurized cabin for crew and passengers maintains 8,000 ft. (2,440 m.) cabin atmosphere at 22,800 ft. (6,955 m.). Two fully-automatic cabin superchargers with manual override control. Thermostatically-controlled heating and cooling. Refrigeration unit cools cabin to 80 degrees Fahrenheit with outside temperature at 99 degrees Fahrenheit. Pilot's compartment in forward portion of fuselage with pilot (on port) and co-pilot side-by-side with dual controls. Flight engineer behind co-pilot facing outboard. Radio-operator behind pilot. Two cabin attendants. Entry to crew compartment on starboard side. Aft of crew compartment is a section which may be used as a galley, buffet, etc. Next follows main passenger cabin, insulated against sound, vibration and outside temperature. Many alternative arrangements allow for total accommodation up to 94 passengers. Two passenger doors and one separate crew door. Two freight compartments with total capacity of 728 cub. ft. (20.6 m.³) below floor of main cabin. Other freight stowage dependent on passenger accommodation. On some Models additional freight, etc. can be carried in an all-metal pannier, known as a "Speedpak," 33 ft. long × 7 ft. wide × 3 ft. deep (10.05 × 2.13 × 0.9 m.) and weighing 1,800 lb. (817 kg.). This is carried under and



The Lockheed R7V-2 used to accelerate the development of the Electra power-plant of four Allison 501 engines.



The Lockheed Model 1649A Starliner (four 3,400 h.p. Wright Turbo Compound engines).

closely fits the contour of fuselage. The "Speedpak" has capacity of 400 cub. ft. (11.32 m.³) and a stowage allowance of 8,200 lb. (3,723 kg.). Built-in electric hoists lower "Speedpak" to ground for loading or unloading. "Speedpak" reduces speed by about 12 m.p.h. (19.2 km.h.).

DIMENSIONS.—
Span 123 ft. 0 in. (37.49 m.).
Length 113 ft. 7 in. (34.65 m.).
Length with nose radome 116 ft. (35.35 m.).
Height over fuselage 18 ft. 10 in. (5.73 m.).
Height overall 24 ft. 9 in. (7.56 m.).

WEIGHTS (Model 1049E).—
Max. take-off loaded weight 133,000 lb. (60,380 kg.).
Max. landing weight 110,000 lb. (49,940 kg.).

PERFORMANCE (Model 1049E).—
Max. speed (fully loaded) 352 m.p.h. (563 km.h.) at 10,500 ft. (3,200 m.).
Max. speed (at max. landing weight) 376 m.p.h. (602 km.h.) at 20,000 ft. (6,050 m.).
Max. cruising speed at 75% power, 331 m.p.h. (530 km.h.) at 23,000 ft. (7,015 m.).
Landing speed 99.5 m.p.h. (159 km.h.).
Initial rate of climb (at max. A.U.W. at S/L.) 1,140 ft./min. (348 m./min.).
Initial rate of climb (at max. A.U.W. at S/L.) one engine inoperative 640 ft./min. (195 m./min.).
Max. range (full fuel, no reserve) at 10,000 ft. (3,050 m.) 4,820 miles (7,710 km.).
Take-off distance to clear 50 ft. (15 m.) with full load, 4,600 ft. (1,403 m.).
Landing distance from 50 ft. (15 m.) at max. landing weight 3,550 ft. (1,083 m.).

THE LOCKHEED 1649A STARLINER.

The Model 1649A is an extra long-range derivative of the Super Constellation, with a completely new wing of thinner section and with an aspect ratio of 12, compared with 9.12 on the Model 049 through to Model 1049H. The entire wing, with minor exceptions, is constructed of large integrally-stiffened panels, up to 40 ft. (12.2 m.) long and measuring from $1\frac{3}{4}$ to $\frac{1}{2}$ in. (4.44 to 1.27 cm.) in thickness.

Cabin noise is reduced by improved sound- proofing, the fact that the engines are mounted five feet further from the cabin than in previous models and by using a lower propeller speed, with an 0.355 reduction compared with 0.4375 on earlier models. The main landing gear has been strengthened and redesigned so that it now retracts into the engine nacelles, eliminating structural cutouts in the wing. All controls are completely new and power-boosted by a 3,000 lb./sq. in. (211 kg./cm.²) hydraulic system.

Model 1649A Starliners have been delivered to the following airlines : Trans-World Airlines 29, Air France 10, Deutsche Lufthansa 4.

The prototype flew on October 10, 1956.

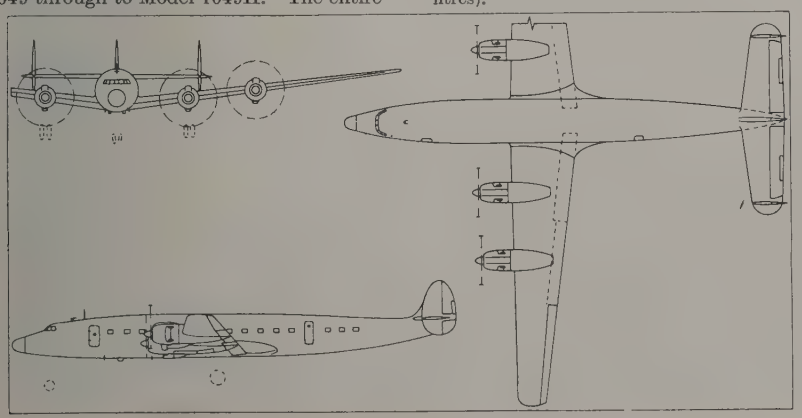
TYPE.—Four-engined Long-range Airliner.

WINGS.—Cantilever low-wing monoplane. NACA wing section one-sixth thinner than that of Model 1049. Aspect ratio 12. Integrally-stiffened all-metal structure. Wing area 1,850 sq. ft. (171.5 m.²).

FUSELAGE AND TAIL UNIT.—Basically similar to Model 1049.

LANDING GEAR.—Redesigned retractable tricycle type.

POWER PLANT.—Four Wright 988TC18EA2 Turbo Compound engines, with 3,400 h.p. each available for take-off and a cruising power of 1,800 h.p. each at 22,600 ft. (6,888 m.). Hamilton Standard or Curtiss three-blade anti-icing, fully-feathering, reversible-pitch airscrews, diameter 16 ft. 10 in. (5.11 m.). Total fuel capacity in integral wing tanks 9,600 U.S. gallons (36,300 litres).



The Lockheed Model 1649A Starliner.

ACCOMMODATION.—Pressurised cabin for crew and passengers. Normal crew for over-land operation is five, with provision for a crew of 11 on long-range over-ocean flights. Normal passenger accommodation on long-range services is for 58 first-class or 80-92 tourist passengers or, on mixed-class services, 26 first-class and 45 tourist. Passenger capacities are slightly higher on domestic operations. Main cabin floor area 744 sq. ft. (69.2 m.²). Lower compartment cargo space 593 cub. ft. (16.79 m.³).

DIMENSIONS.—
Span 150 ft. (45.6 m.).
Length (with radar) 116 ft. 2 in. (35.4 m.).
Length (without radar) 113 ft. 7 in. (34.62 m.).
Height 23 ft. 5 in. (7.14 m.).

WEIGHTS.—
Weight empty 85,262 lb. (38,675 kg.).
Max. gross take-off weight 156,000 lb. (70,700 kg.).
Max. landing weight 123,000 lb. (55,800 kg.).
Max. zero fuel weight 116,000 lb. (52,500 kg.).

PERFORMANCE (estimated).—
Max. speed at 18,600 ft. (5,670 m.) 377 m.p.h. (607 km.h.).
Max. cruising speed at max. landing weight at 22,600 ft. (6,888 m.) 342 m.p.h. (550 km.h.).
Stalling speed at max. landing weight (flaps down) 101 m.p.h. (163 km.h.).
Rate of climb at S/L. at 156,000 lb. (70,700 kg.) A.U.W. 1,080 ft./min. (330 m./min.).
Service ceiling at 156,000 lb. (70,700 kg.) A.U.W. 23,700 ft. (7,225 m.).
Take-off distance to clear 50 ft. (15.25 m.) at 156,000 lb. (70,700 kg.) A.U.W. 5,700 ft. (1,737 m.).
Landing distance at max. landing weight 3,600 ft. (1,100 m.).
Max. range, no reserves, at 15,000 ft. (4,570 m.) 7,200 miles (11,585 km.).

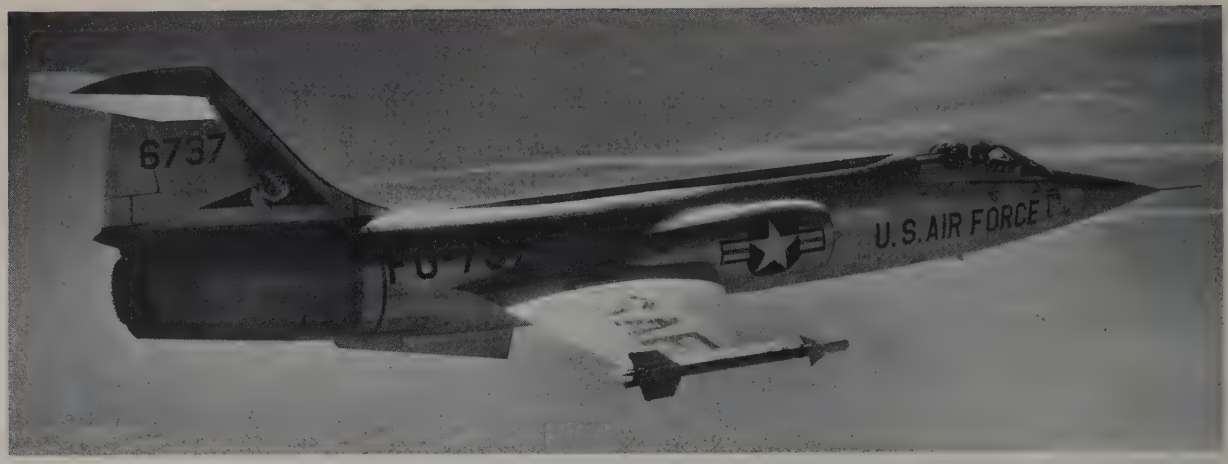
THE LOCKHEED STARFIGHTER.
U.S.A.F. designation: F-104.

The Starfighter is a supersonic "air superiority" fighter which is claimed to be the World's fastest combat aircraft. It is in quantity production for the U.S.A.F. at the California Division of the company.

Although no performance figures have been released, an F-104A set up a World Speed Record of 1,404.19 m.p.h. (2,259.85 km.h.) on May 16, 1958 ; another established a World Aeroplane Height Record of 91,249 ft. (27,813 m.) on May 7, 1958.

Development of the design began in 1951 and versions so far announced are :—

XF-104. Two prototypes were built under this designation, with Wright J65 turbojet engine and afterburner. First flight of first XF-104 February 7, 1954.



The Lockheed F-104A Starfighter (General Electric J79 engine with afterburner).

F-104A. General Electric J79-GE-3A turbojet engine. Single-seat interceptor and tactical support aircraft. In quantity production. The first production F-104A flew for the first time on February 17, 1956 and deliveries to the U.S.A.F. Air Defense Command began on January 26, 1958.

F-104B. Tandem two-seat development of the F-104A, for use as both combat aircraft and operational trainer. Has considerably greater fin area and fully-powered rudder. Prototype flew on February 7, 1957. For U.S.A.F. Air Defense Command.

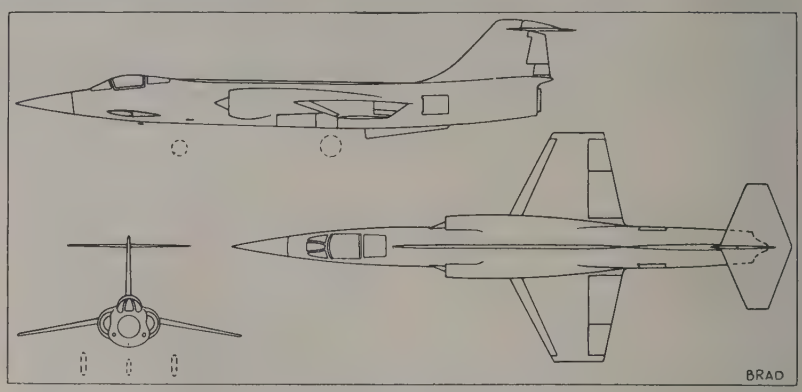
F-104C. For U.S.A.F. Tactical Air Command. Fitted with Lockheed in-flight refuelling equipment with removable probe. Deliveries began on October 16, 1958.

F-104D. Two-seat version of F-104C for U.S.A.F. Tactical Air Command. Similar to F-104B but with in-flight refuelling equipment and other modifications introduced in F-104C.

Details given below refer specifically to the single-seat F-104A version, but apply generally to all versions of the F-104.

The F-104 has a simplified structure, giving an empty airframe weight only about half that of other fighters in the U.S.A.F.'s "Century" series.

An automatic pitch control system is fitted to sense and prevent stalling, together with a Lear three-axis autostabilizer. A boundary layer control system is used to decrease landing speed. The boundary layer control system operates automatically, blowing air bled from the turbojet compressor over the wing flaps whenever the flaps are extended beyond the take-off setting.



The Lockheed F-104A Starfighter.

TYPE.—Single-seat Supersonic Fighter.

WINGS.—Mid-wing cantilever monoplane. Symmetrical supersonic wing section with a thickness/chord ratio of 3.4%. Aspect ratio 2.97. Leading-edge nose radius of 0.016 in. and razor-sharp trailing-edge. All metal multi-spar structure. Each half wing measures 7 ft. 6 in. (2.29 m.) from root to tip and is a separate structure cantilevered from bulkhead strongpoint on the fuselage median line. Wings have a 10° negative dihedral. Full-span electrically-actuated drooping leading-edge. Entire trailing-edge hinged, with inboard sections serving as landing flaps and outboard sections as ailerons. Ailerons operated hydraulically. Flaps actuated electrically. Above each flap is the air delivery tube of a boundary layer control system, which ejects air bled from the engine compressor over the entire flap span whenever the flaps are lowered more than 15°. Net wing area 120 sq. ft. (11.15 m.²).

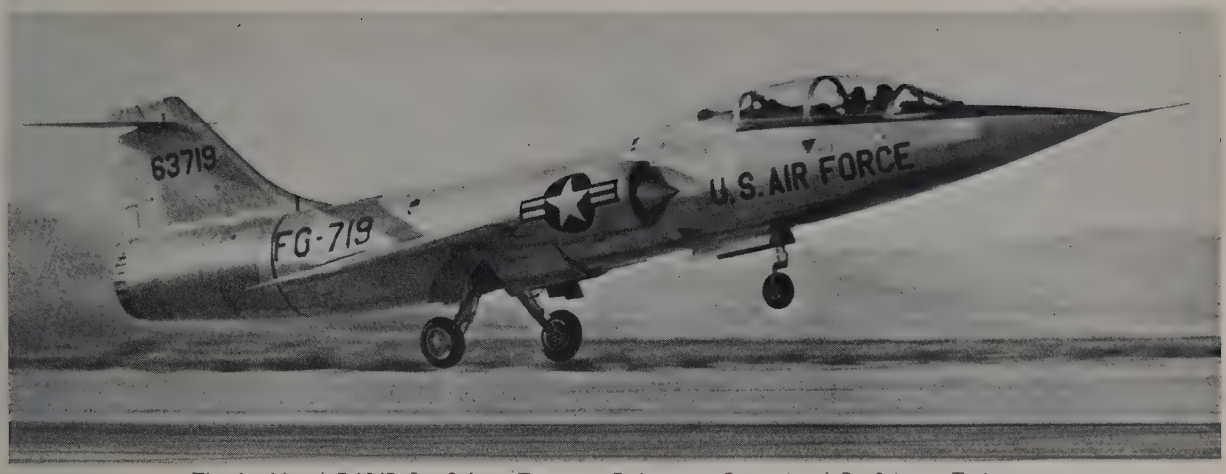
FUSELAGE.—All-metal monocoque structure.

TAIL UNIT.—T-type cantilever monoplane unit with "all-flying" one-piece tail hinged at mid-chord point at top of the sweptback vertical fin. Tailplane has similar profile to wing and is all-metal. Autostabilizer tab at base of rudder. Narrow-chord ventral fin to improve stability. Vertical tail area approximately 40 sq. ft. (3.72 m.²). Horizontal tail area approximately 45.5 sq. ft. (4.22 m.²). Tailplane span 11 ft. 11 in. (3.63 m.).

LANDING GEAR.—Retractable tricycle type. Cleveland Pneumatic (Dowty patent) liquid-spring shock-absorbers. Hydraulic actuation. Main wheels raised in and forward. Steerable nose-wheel retracts forward into fuselage. Main wheel legs are hinged on oblique axes so that the wheels lie flush within the fuselage skin when retracted. Goodrich tyres, pressure over 250 lb./sq. in. (17.58 kg./cm.²). Anti-skid multi-disc brakes on main wheels. Hydraulically-operated air-brake on each side of rear fuselage. Drag parachute stowed in lower



The Lockheed F-104A Starfighter (General Electric J79 turbojet engine and afterburner). (*Robert Archer*).



The Lockheed F-104B Starfighter Two-seat Fighter or Operational Proficiency Trainer.

part of fuselage near end of tailpipe. Wheel track 8 ft. 9 in. (2.67 m.). Wheelbase 15 ft. 1 in. (4.60 m.).

POWER PLANT.—One General Electric J79-GE-3A axial-flow turbojet engine with afterburner, rated at approximately 11,000 lb. (4,990 kg.) s.t. dry and over 16,000 lb. (7,260 kg.) with afterburning. Most of the aircraft's hydraulic equipment mounted inside large engine access door under fuselage to facilitate servicing. Internal fuel in fuselage tanks with total capacity of 908 U.S. gallons (3,437 litres). Provision for up to four 500 U.S. gallon (1,890 litre) auxiliary under-wing pylon tanks.

ACCOMMODATION.—Pressurised and air-conditioned cockpit well forward of wings. Automatic downward pilot ejection system operates in the following sequence after release handle is pulled: (*a*) cockpit is depressurised and control column moved forward out of way; (*b*) parachute shoulder harness is tightened, pilot's legs are pulled close together and ankle clamps secure feet in place; (*c*) an explosive cartridge releases escape hatch and jettisons seat downwards and outwards; (*d*) pilot's seat belt unsnaps, freeing him from seat, and at a pre-set altitude parachute opens.

ARMAMENT.—20 mm. T-171-E3 Vulcan six-barrel cannon developed by General Electric, in port underside of nose, and one Philco AAM-N-7 Sidewinder missile on each wing-tip. Provision for under-wing stores, including podded T-171 cannons, for ground attack or tactical support missions. ASG-14 fire-control system.

EQUIPMENT.—Integrated electronics system in which various communications and navigation components may be installed as a series of interconnecting but self-sustaining units which may be varied to provide for different specific missions.

DIMENSIONS.—
Span (without tip-tanks) 21 ft. 11 in. (6.68 m.).
Length 54 ft. 9 in. (16.61 m.).
Height 13 ft. 6 in. (4.11 m.).

WEIGHTS.—
Normal take-off weight, internal fuel only, 17,000 lb. (7,710 kg.).
Normal take-off weight with tip-tanks 19,200 lb. (8,709 kg.).
Max. take-off weight with tip-tanks and under-wing tanks 22,000 lb. (9,980 kg.).
Landing weight 11,500 lb. (5,215 kg.).

PERFORMANCE.—
Max. speed approx. Mach 2.2 to 2.3 at 35,000 ft. (10,670 m.).
Approach speed 200 m.p.h. (322 km.h.).
Landing speed 164 m.p.h. (264 km.h.).
Max. range for ferrying 2,200 miles (3,540 km.).

THE LOCKHEED U-2.

The Lockheed U-2 is a research aircraft, of which a small number are being used by the NACA for high-altitude meteorological research in the United States and Europe and others by the U.S.A.F.'s 4,028th Strategic Reconnaissance Squadron in Texas. A requirement of its design was that it should be able to maintain flight at altitudes above 50,000 ft. (15,250 m.), and U-2's have in fact undertaken many sorties up to 55,000 ft. (16,765 m.) to gather data for the U.S.A.F.'s Air Weather Service.

An unusual feature is that the small underwing balancer wheels made necessary by the tandem landing gear are jettisoned after take-off, so that after landing the aircraft tips on to one of its turned-down wingtips.

Among specific data sought by use of the U-2 are more precise information about clear-air turbulence, convective clouds, wind shear and the jet stream. In addition, information on cosmic radiation and the concentration of certain elements in the atmosphere, including ozone and water vapour, is being gathered at the request of the U.S.A.F. To this end, the U-2 is very fully instrumented with equipment supplied by NACA and the Wright Air Development Center.

TYPE.—High-altitude Research monoplane.

WINGS.—Mid-wing cantilever monoplane with turned down tips. High aspect ratio. All metal structure.

FUSELAGE.—All metal monocoque structure. Air brakes on each side of rear fuselage.

TAIL UNIT. Cantilever monoplane type. All metal structure.

LANDING GEAR.—Retractable tandem tail-wheel type. Main and tail units each fitted with double wheels. Small jettisonable balancer wheels under wings. Braking parachute in container under rudder.

POWER PLANT.—One Pratt & Whitney J57 turbojet engine.

ACCOMMODATION. — Normal accommodation for pilot only under rearward-sliding canopy.

DIMENSIONS (approx.).—
Span 90 ft. (27.43 m.).
Length 45 ft. (13.72 m.).

PERFORMANCE.—
Limiting Mach number approx. 0.75.

THE LOCKHEED T-33/TV-2.

U.S. Air Force designations: T-33 and RT-33. U.S. Navy designation: TV-2.

Developed from the Shooting Star jet-fighter, the T-33A is the standard jet trainer in service in the U.S.A.F., U.S. Navy and U.S. Marine Corps, and has been supplied to the air forces of twelve M.D.A.P. nations. It has also been bought by four Latin-American powers—Cuba, Colombia, Peru and Venezuela.

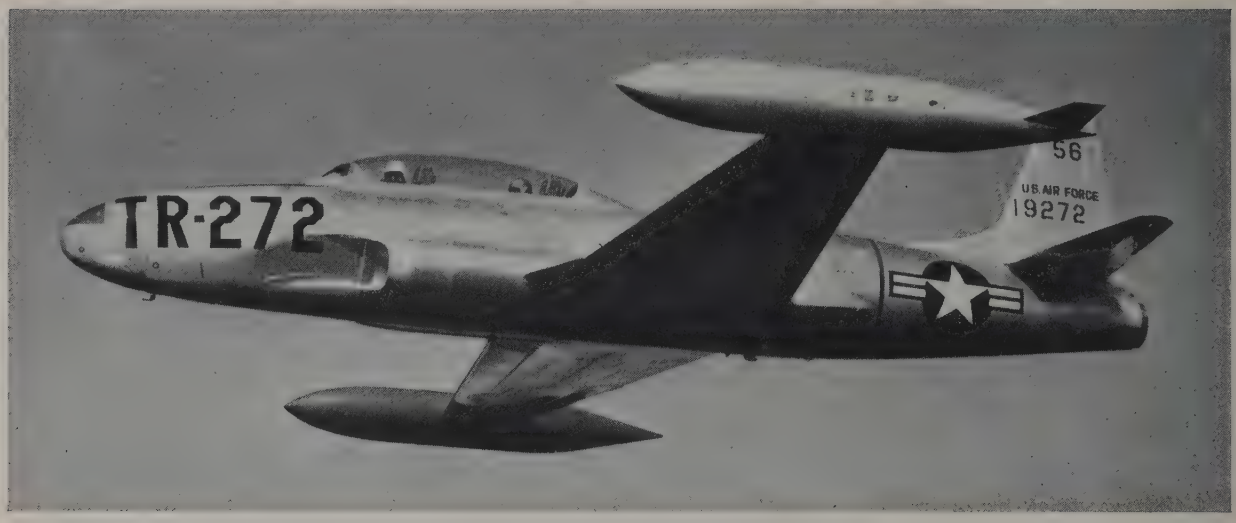
Current orders for the T-33A will keep it in production until late 1959 and will bring total deliveries of the type to almost 5,700.

The following are the current versions:—

T-33A. Allison J33-A-35 engine (5,200 by = 2,360 kg. s.t.). Fuselage lengthened by 38.6 in. (98.1 cm.), 26.6 in. forward of wings and 12 in. aft, to accommodate extra seat. Both seats under a continuous canopy hinged at rear edge and raised electrically or manually from either inside or outside aircraft. Smaller fuselage fuel tank (95 U.S. gallons = 360 litres)



The Lockheed U-2 Single-seat Research Aircraft (Pratt & Whitney J57 turbojet engine).



The Lockheed T-33A Shooting Star Two-seat Trainer (Allison J33-A-35 turbojet engine).

and larger wing tanks, which are nylon cells instead of self-sealing type. Instructor in rear seat. Originally, all T-33A's had a fixed armament of two .50 in. machine-guns in their nose. New production T-33's ordered in 1955 have all-weather "navigational noses" instead of guns and many of those already in service are being modified. The new equipment includes the first combined radio compass sense antenna and VOR device, and is dual-operated with controls in both cockpits.

The T-33 is built under licence by Canadair, Ltd. Canadian production aircraft are powered by Rolls-Royce Nene engines. It is also being assembled in Japan by Kawasaki from components manufactured by Lockheed.

RT-33A. Single-seat photographic reconnaissance version of the T-33. Carries a battery of four mapping and charting cameras and a wire recorder, to enable the pilot to make a record of the flight over the target, to elaborate on particular features of the terrain and to record height and position. Operational range of the RT-33 is said to be approximately 20 per cent. greater than that of the standard two-seat T-33.

TV-2. U.S. Navy version of the T-33A two-seat trainer.

A full structural description of the T-33 has appeared in previous editions of "All the World's Aircraft."

DIMENSIONS (T-33A).—
Span 38 ft. 10½ in. (11.85 m.).
Length 37 ft. 8 in. (11.48 m.).
Height 11 ft. 8 in. (3.55 m.).

WEIGHTS (T-33A).—
Weight empty 8,400 lb. (3,810 kg.).
Weight loaded 11,965 lb. (5,432 kg.).

PERFORMANCE (T-33A).—
Max. speed at S/L. 600 m.p.h. (960 km.h.).
Max. speed at 25,000 ft. (7,620 m.) 543 m.p.h. (874 km.h.).
Stalling speed (with flaps) 102 m.p.h. (164 km.h.).
Stalling speed (without flaps) 113 m.p.h. (182 km.h.).
Climb to 25,000 ft. (7,620 m.) 6.5 min.
Service ceiling 47,500 ft. (14,480 m.).
T.O. distance to 50 ft. (15.25 m.) (with water injection) 2,560 ft. (780 m.).
Landing distance from 50 ft. (15.25 m.) 3,480 ft. (1,061 m.).
Endurance 3.12 hours.

THE LOCKHEED SEASTAR.
U.S. Navy designation: T2V-1.

The SeaStar, developed from the T-33 as a "private venture" two-seat all-purpose jet trainer, has been adopted by the U.S. Navy in modified form as a "sea duty" trainer. The prototype flew for the first time on December 15, 1953, and a production T2V-1 SeaStar completed its carrier suitability trials in the summer of 1957. It is the first U.S. aeroplane to be ordered into production with boundary-layer control as standard equipment, and is the first operational jet trainer designed to perform pilot training operations in sea-going carriers as well as from land bases.

A large additional order announced in November, 1956 extended production into 1958.

TYPE.—Two-seat Naval Jet Trainer.

WINGS.—Low-wing cantilever monoplane. All-metal structure similar to that of T-33 Shooting Star but fitted with movable leading-edge slats and boundary-layer control. Compressed air tapped from engine is ducted in tubes along trailing-edges and blown at high speed through slots in tubes over upper surfaces of flaps to increase lift and delay approach to stall. Powered ailerons. Full-span automatic leading-edge slats.

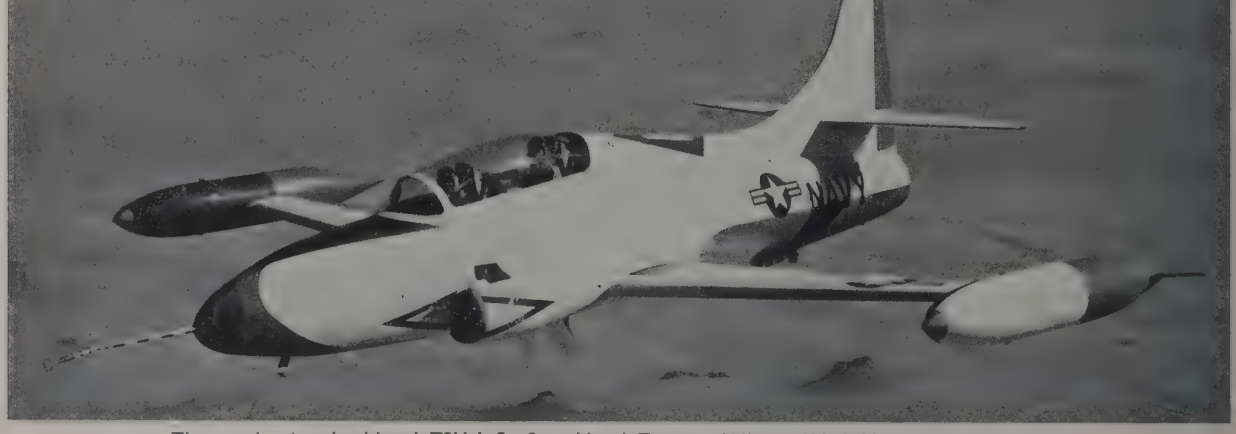
FUSELAGE.— Light-alloy semi-monocoque structure.

TAIL UNIT.—Cantilever monoplane type. All-metal structure similar to that of T-33 but tailplane raised 20 in. (50.8 cm.) to position on fin, the span increased by 12 in. (30.5 cm.) and dorsal fin extension added.

LANDING GEAR.—Retractable nose-wheel type. Similar in general to that of T-33 but strengthened to absorb four times more energy on landings and take-offs. Nose-wheel strut can be hydraulically lengthened when in extended position to raise nose of aircraft for faster climbs on carrier catapult take-offs. Arrester hook under fuselage is extended hydraulically and maintained in position pneumatically.

POWER PLANT.—One Allison J33-A-22 turbojet engine (6,100 lb.=2,770 kg. s.t.) in production T2V-1. Alternatively Pratt & Whitney J48-P-8 (7,250 lb.=3,415 kg. s.t.) may be fitted. Fuel in fuselage tank (300 U.S. gallons=1,134 litres) and two non-jettisonable wing-tip tanks (230 U.S. gallons =870 litres each). Wing-tip fuel can be dumped in flight by ram air. Total fuel capacity 760 U.S. gallons (2,874 litres).

ACCOMMODATION.—Tandem seats with dual controls under jettisonable one-piece clam-shell type canopy. Rear (instructor's) seat 6 in. (15.2 cm.) higher than front seat. Ejector seats. Auxiliary inside windscreen of laminated aluminium in rear cockpit is raised automatically for wind-blast protection when canopy is jettisoned.



The production Lockheed T2V-1 SeaStar Naval Trainer (Allison J33-A-22 turbojet engine).

EQUIPMENT.—Navigational equipment includes radio and ADF installation, glide path receiver and VOR localizer, and BIA attitude gyro, a combination homing device and gyro compass. Two-in-one instruments on control panel which, by use of selector switches, give individual readings from two devices on one dial.

DIMENSIONS.—
Span (over tip-tanks) 42 ft. (12.8 m.).
Length 38 ft. (11.6 m.).
Height 13 ft. (3.9 m.).

WEIGHTS.—
Weight empty 11,500 lb. (5,217 kg.).
Weight loaded 15,500 lb. (7,030 kg.).

PERFORMANCE.—
Max. speed at 35,000 ft. (10,670 m.) 580 m.p.h. (933 km.h.).
Landing speed 97 m.p.h. (155 km.h.).
Rate of climb at S/L 5,400 ft./min. (1,645 m./min.).
Service ceiling 40,000 ft. (12,200 m.).
Range about 900 miles (1,440 km.).

THE LOCKHEED NEPTUNE.
U.S. Navy designation : P2V.

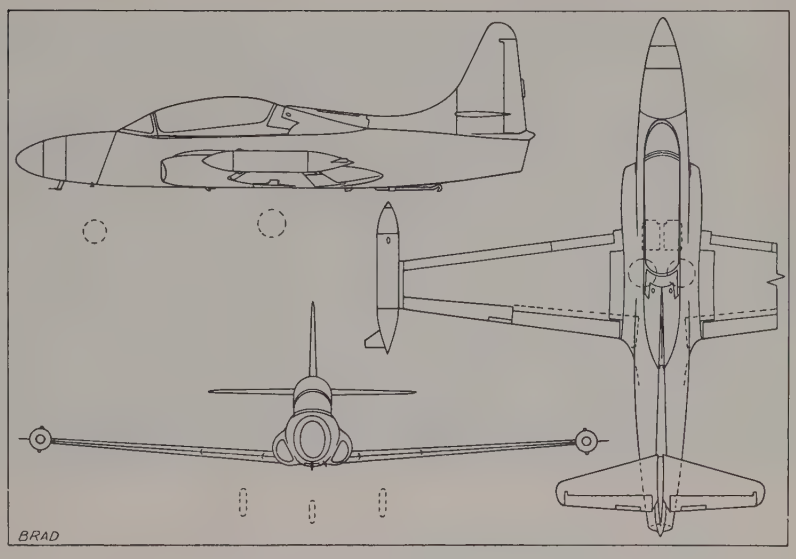
The first U.S. Navy contract for the Neptune was placed in April, 1944, for two XP2V-1's. Since then Lockheed has received one contract for the P2V-1, two for the P2V-2, two for the P2V-3, one for the P2V-4, ten for the P2V-5, three for the P2V-6 and seven for the P2V-7. The current P2V-7 contract will extend production through to September, 1960.

In addition a contract was received in October, 1954, for the conversion of all P2V-5's and P2V-6's to P2V-7 standard with auxiliary jet power. This modification programme will require three years to complete.

In addition to world-wide service with the U.S. Navy, the Neptune has also been supplied to the Royal Air Force, the Royal Australian Air Force, the Royal Canadian Air Force, the Royal Netherlands Air Force, the French Navy and the Japanese Maritime Self-Defence Force.

It was announced in April, 1958 that Lockheed will provide technical assistance and material for the manufacture in Japan by the Kawasaki company of an undisclosed number of P2V-7 aircraft.

Between September 29 and October 1, 1946, the third production P2V-1, suitably modified, set up a World's Record for Distance in a Straight Line by flying non-stop from Perth, Western Australia, to Columbus, Ohio, U.S.A., a distance of 11,235 miles (17,976 km.). Flight time was 55 hours 17 min.



The Lockheed T2V-1 SeaStar Naval Trainer.

The principal current versions of the Neptune are :—

P2V-5. Has flexible nose gun turret armed with two 20 mm. cannon in place of the fixed nose armament of earlier versions. Larger wing-tip tanks carrying radar and searchlight as well as extra fuel. Considerably more internal radar and electronic equipment. First model to be fitted with elongated tail enclosing anti-submarine magnetic airborne detection (MAD) gear. All P2V-5's modified for installation of two Westinghouse J34 turbojet engines in wing-mounted pods as in P2V-7.

P2V-6. Similar to P2V-5 but specially equipped for mine-laying and anti-submarine warfare. Longer nose to give added room for forward crew and improved access to equipment, smaller wing-tip tanks and smaller radome. New features include stainless steel engine nacelles and pressure fuelling. Interchangeability for mine-laying and anti-submarine work permits a wide selection of armament. In particular, the P2V-6B is equipped to carry Fairchild Petrel air-to-surface missiles under its wings. All P2V-6's modified for installation of two Westinghouse J34 turbojet engines in wing-mounted pods as in P2V-7.

P2V-7. Two 3,500 h.p. Wright R-3350-32W Turbo Compound engines, plus two Westinghouse J34 turbojets (3,400 lb.= 1,540 kg. s.t. each) in wing-mounted pods outboard of engine nacelles to augment take-off and combat performance. Enlarged crew space and other interior modifications of a classified nature ; bulged cockpit canopy for improved all-round view ; modified nose landing-gear unit ; redesigned wing-tip tanks ; and simplified multi-function control systems. Like all other models, the P2V-7 can be converted for patrol, mine-laying or torpedo bomber duties. The latest models have Emerson Electric turrets with two 20 mm. cannon in place of .50 in. machine-guns in mid-upper position.

The following description applies generally to the P2V Series :—

TYPE.—Twin-engined Naval Patrol Bomber.

WINGS.—All-metal cantilever mid-wing monoplane. Aerofoil section NACA 2419 modified with max. thickness at 38% of chord. Wing designed to give temporary flotation in event of ditching. Centre-section wing



The Lockheed P2V-7 Neptune (two 3,500 h.p. Wright R-3350 Turbo Compound engines and two Westinghouse J34 turbojets).



A Lockheed P2V-7 Neptune as supplied to the Japanese Maritime Self-Defence Force.

box continuous through fuselage and entire bomb-bay load carried directly by wing. All-metal ailerons with controllable trim-tab in each. Lockheed-Fowler flaps on circular arc racks inboard of ailerons. Max. flap depression 32°. Ailerons also droop 10° when flaps lowered. Internal aerodynamic balances on all control surfaces. Thermal leading-edge de-icing. Gross wing area 1,000 sq. ft. (92.9 m.²).

FUSELAGE.—All-metal semi-monocoque structure.

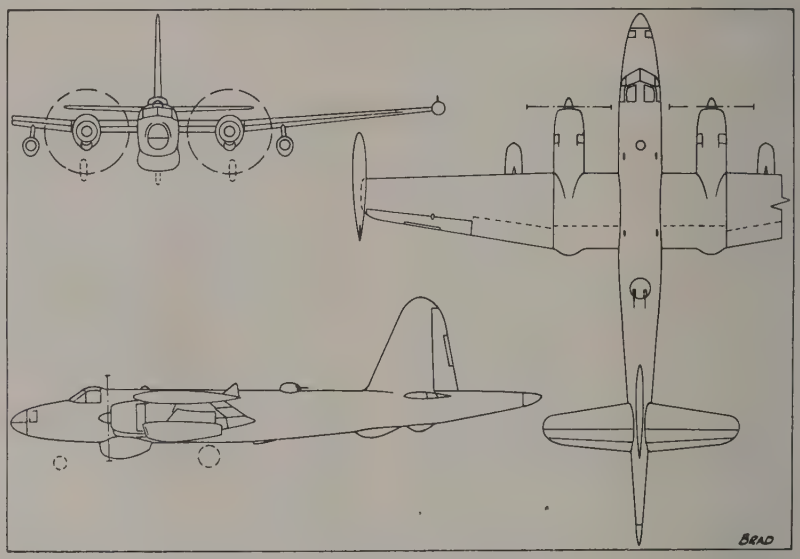
TAIL UNIT.—Cantilever monoplane type, with metal covering over all surfaces. Tail-unit incorporates "Varicam" (variable camber), a movable trimming surface between fixed tail and elevator which is operated by electrically-driven irreversible screw-jack. Tailplane and fin have detachable thermally-heated leading-edges. Vertical fin area 17% of wing area. Balanced control surfaces, with trim-tab in each elevator. Trim-balance tabs in rudder. Elevator area (each) 39.3 sq. ft. (3.65 m.²). Rudder area 38.4 sq. ft. (3.57 m.²).

LANDING GEAR.—Retractable tricycle type. Hydraulic brakes on main wheels.

POWER PLANT.—Two Wright R-3350 eighteen-cylinder two-row radial air-cooled engines. Hamilton Standard Hydromatic three-blade constant-speed airscrews, 15 ft. 2 in. (4.62 m.) diameter. Most P2V-5, P2V-6 and P2V-7 aircraft also have two Westinghouse J34 turbojets (each 3,400 lb.=1,540 kg. s.t.) in underwing pods. Self-sealing fuel tanks with nylon plastic casing. Normal fuel capacity 2,200 U.S. gallons (8,316 litres). Provision for 700 U.S. gallon (2,646 litres) ferrying tank in bomb-bay. Dural armour in nacelles.

ACCOMMODATION.—Crew of seven: pilot, co-pilot, navigator/bombardier (who handles radar bombing gear), radar operator, and dorsal and rear gunners. All positions armoured. Galley and sleeping accommodation.

ARMAMENT.—Up to six 20 mm. forward-firing cannon in nose; two .5-in. (12.7 mm.) flexible machine-guns in dorsal turret (two



The Lockheed P2V-7 Neptune.

20 mm. cannon in latest P2V-7's); and two flexible 20 mm. cannon in power-operated tail-turret. Provision for sixteen 5-in. (12.7 cm.) rocket projectiles under wings. Bomb-load of 8,000 lb. (3,629 kg.) carried internally may consist of sixteen 500 lb. (227 kg.), eight 1,000 lb. (454 kg.) or four 2,000 lb. (907 kg.) bombs, two 2,165 lb. (982 kg.) torpedoes, or 2,000 lb. (907 kg.) sea-mines, or twelve 325 lb. (147 kg.) depth-charges. MAD gear. Sonobuoy installation.

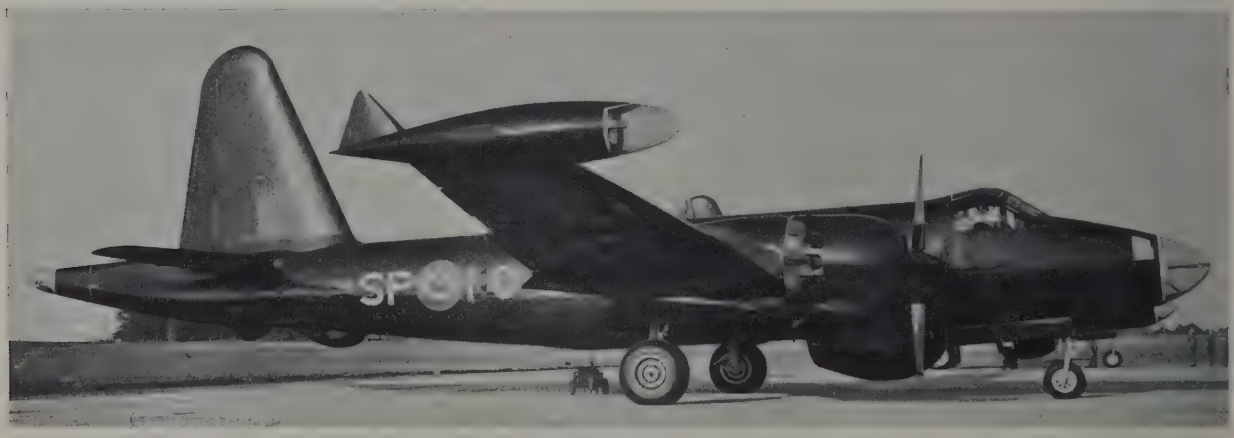
DIMENSIONS (P2V-3).—
Span 100 ft. 0 in. (30.48 m.).
Length 76 ft. 10 in. (23.43 m.).
Height (over rudder) 28 ft. 1 in. (8.5 m.).

DIMENSIONS (P2V-7).—
Span (with tip tanks) 103 ft. (31.5 m.).
Length 91 ft. 5 in. (27.9 m.).
Height 29 ft. 4 in. (8.94 m.).

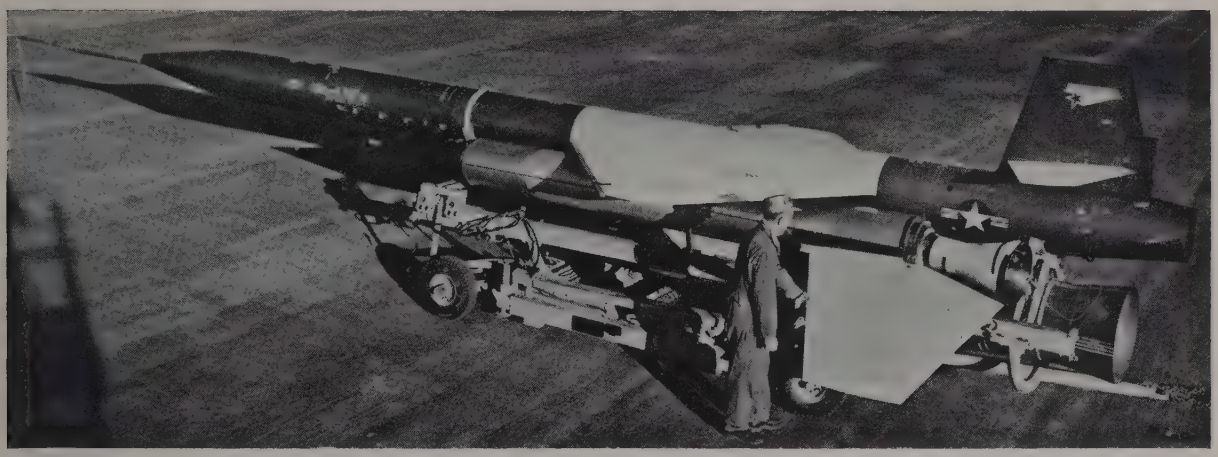
WEIGHTS (P2V-3).—
Weight empty 34,683 lb. (15,746 kg.).
Disposable load 23,317 lb. (10,586 kg.).
Max. take-off weight 58,000 lb. (26,300 kg.).
Landing weight 54,000 lb. (24,520 kg.).

WEIGHTS (P2V-7).—
Weight empty (without auxiliary jets) 43,950 lb. (19,950 kg.).
Weight empty (with jets) 47,450 lb. (21,540 kg.).
Weight loaded (without auxiliary jets) 72,000 lb. (32,670 kg.).
Weight loaded (with jets) 75,500 lb. (34,280 kg.).

PERFORMANCE (P2V-3).—
Max. speed 300 m.p.h. (483 km.h.).



A Lockheed P2V-7 Neptune of the Royal Canadian Air Force. The Canadian P2V-7's do not have the auxiliary jet pods. (*Gordon Williams*).



The Lockheed Q-5 Kingfisher Ramjet-powered Target Drone.

Stalling speed (power on) 77 m.p.h. (123.2 km.h.).
Initial rate of climb (T.O. weight) 2,086 ft. min. (636 m./min.).
Service ceiling 27,100 ft. (8,265 m.).
Range 3,560 miles (5,696 km.) at 180 m.p.h. (288 km.h.) at 1,500 ft. (460 m.).
T.O. distance to clear 50 ft. (15.25 m.) (T.O. weight and power) 947 yds. (866 m.).

THE LOCKHEED KINGFISHER.
U.S. Army designation: Q-5.

Developed by the Lockheed Missile Systems Division, the Kingfisher is a ramjet-powered target drone which uses many components of the X-7 test vehicle. It is used by the U.S. Army.

Its electronic equipment includes a special radar target augmentation device that enables the drone to simulate a wide variety of aircraft and missiles, producing "echoes" of the kind that would be received from a large bomber if necessary. A firing error indicator records theoretical hits or near misses and the pass angle of interceptor missiles.

A parachute and nose spike enable the Kingfisher to be recovered undamaged after flight for re-use.

DIMENSIONS.—
Span 10 ft. (3.05 m.).
Length 38 ft. (11.58 m.).
Body diameter 1 ft. 8 in. (0.50 m.).

WEIGHT.—
Weight loaded over 7,600 lb. (3,450 kg.).

PERFORMANCE.—
Cruising speed above Mach 2.

McDONNELL

McDONNELL AIRCRAFT CORPORATION.

HEAD OFFICE AND WORKS: St. Louis 3, Missouri.

President and Chairman of the Board: J. S. McDonnell, Jr.

Vice-President and General Manager: R. H. Charles.

Vice-President, Manufacturing: C. Warren Drake.

Vice-President, Engineering: Kendall Perkins.

Vice-President, Airplane Engineering: G. C. Covington.

Vice-President, Personnel: W. R. Orthwein, Jr.

Vice-President, Sales and Service: J. F. Aldridge.

Vice-President, Project Management: David S. Lewis.

Chief Engineer, Helicopters: Fred Doblhoff.

Chief Engineer, Missiles: B. G. Bromberg.

Factory Manager: W. F. Burke.

Secretary: Thomas G. Rutledge.

Treasurer: J. H. Cinnater.

The McDonnell Aircraft Corporation was incorporated on July 6, 1939. Since that date the activities of the company have been devoted exclusively to the development and production of aircraft and missiles for the U.S. Government.

The latest operational U.S. Navy fighter of McDonnell design is the F3H Demon, a swept-wing carrier fighter. To follow the Demon, McDonnell has developed the F4H, a long-range two-seat interceptor fighter. It is powered by two General Electric J79 engines, and has improved firepower and radar. Designed for Mach 2 speeds, the prototype flew for the first time on May 27, 1958.

For the U.S. Air Force McDonnell is building four versions of the long-range twin-jet swept-wing Voodoo, the F-101A long-range interceptor and RF-101A photographic reconnaissance fighters for the Tactical Air Command, the F-101B interceptor fighter for the Air Defense Command and the F-101C fighter-bomber. All versions of the Voodoo are supersonic in a climb.

McDonnell is also actively engaged in rotary-wing development. It is continuing development of the XV-1 convertiplane, and has built the prototype of a small flying crane helicopter designated the Model 120.

In the missile field, McDonnell is the prime contractor for the development of the GAM-72 Green Quail decoy missile and manufactures the airframe and propulsion units for the Talos beam-riding missile. Available details will be found in the Missile Section.

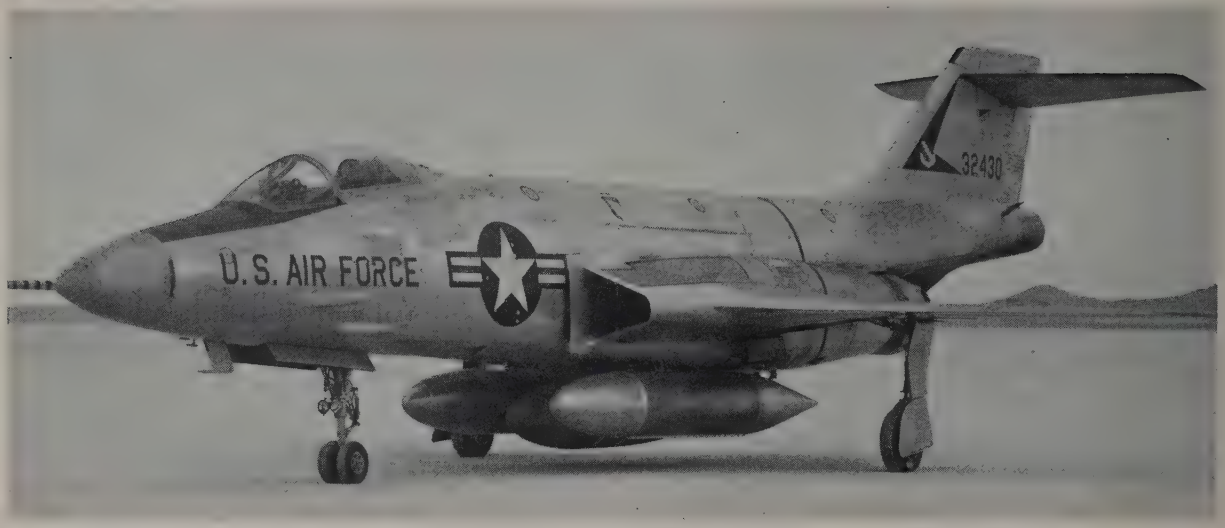
THE McDONNELL VOODOO.
U.S. Air Force designation: F-101 and RF-101.

The original XF-88 and XF-88A swept-wing twin-jet fighters, the latter with afterburners, underwent successful evaluation by the U.S.A.F. in 1949 and 1950, but owing to a cut-back in defense funds and a change in tactical requirements, the experimental contract was terminated in August, 1950.

After a period of over a year the XF-88A was revived and, with modifications, was ordered into production under



McDonnell F-101A Voodoo Single-seat Long-range Interceptor Fighters awaiting delivery to the U.S.A.F.



The McDonnell F-101A Voodoo (two Pratt & Whitney J57 engines with afterburners).

the designation F-101A, and has since been developed with the RF-101A, F-101B and F-101C versions, brief details of which follow.

F-101A. Two Pratt & Whitney J57-P-13 engines with afterburners. First production version. First F-101A flew on September 28, 1954, and exceeded Mach 1 on its first flight. Armament consists of four 20 mm. cannon, plus three Hughes GAR-1 Falcon missiles and 12 rockets. It has rotary bomb doors on which Falcons and other stores of various types can be carried. Probe-drogue, Flying Boom or "buddy tank" air refuelling systems. The F-101A has been in squadron service with Tactical Air Command, U.S.A.F., since May, 1957. On December 12, 1957, an F-101A flown by Major Adrian Drew, U.S.A.F., set up a new World's Speed Record of 1,207.6 m.p.h. (1,943.5 km.h.) over the measured course at Edwards AFB, California.

RF-101A. Two Pratt & Whitney J57-P-13 turbojet engines (10,000 lb. = 4,540 kg. s.t. (dry) each) with afterburners. Long range photographic-reconnaissance aircraft for Strategic Air Command. Comprehensive and fully-automatic camera equipment installed in lengthened forward fuselage, but otherwise airframe, power-plant, etc. same as F-101A. In service with Tactical Air Command since May, 1957.

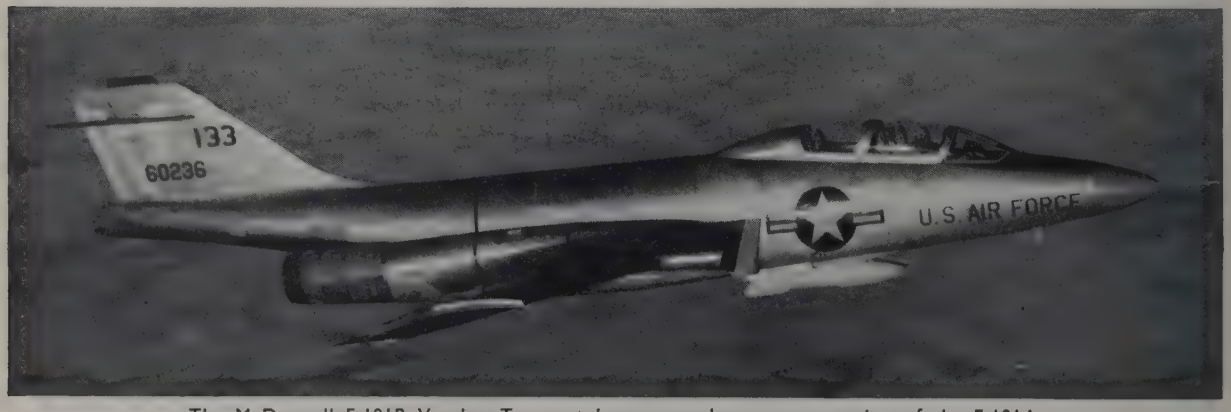
F-101B. Two Pratt & Whitney J57-P-55 engines with afterburners. Long-range two-seat interceptor version of F-101A in service with U.S.A.F. Air Defense Command. First flown on March 27, 1957. Armed with two Douglas MB-1 Genie unguided air-to-air nuclear missiles carried externally. Smaller missiles or bombs carried internally on rotating bomb-door.

F-101C. Similar to F-101A, but strengthened for low-level fighter-bomber operations. Pylon and crutch for atomic weapons under fuselage, between two 450 U.S. gallon (1,705 litre) external tanks. 20 mm. guns retained.

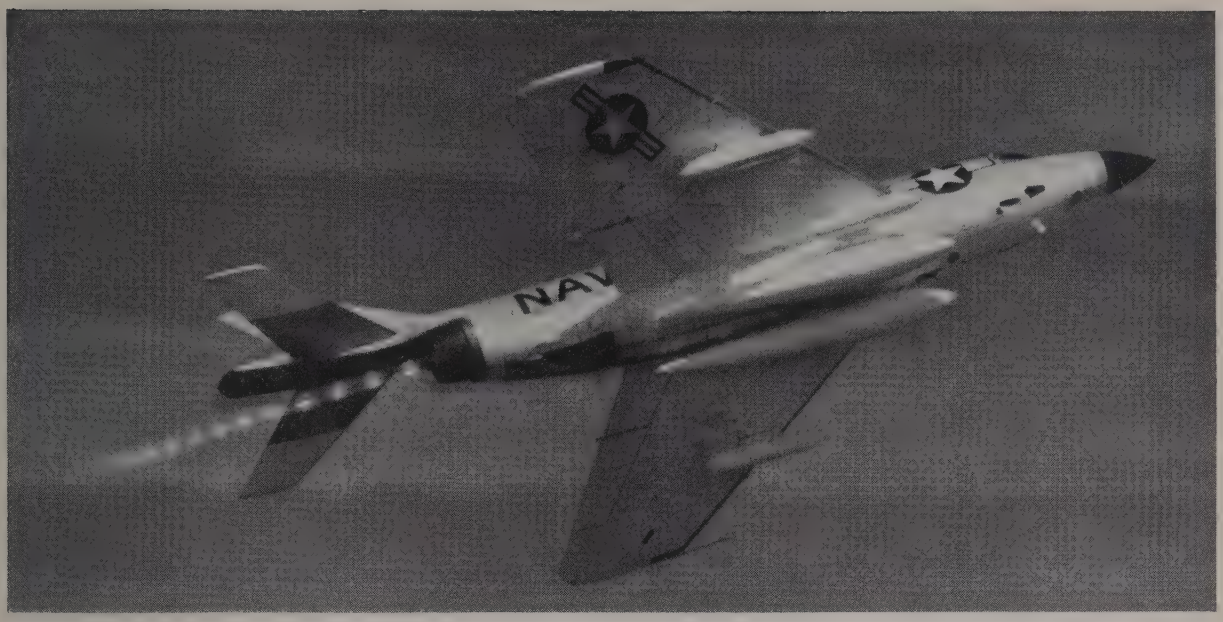


The McDonnell RF-101A Voodoo Long-range Photographic Reconnaissance Aircraft.

DIMENSIONS (F-101B).—
Span 39 ft. 8 in. (12.09 m.).
Length 67 ft. 5 in. (20.55 m.).
Height 18 ft. (5.49 m.).



The McDonnell F-101B Voodoo Two-seat Long-range Interceptor version of the F-101A.



The McDonnell F3H-2N Demon Carrier Fighter (Allison J71 turbojet engine with afterburner).

PERFORMANCE (F-101C).—
Max. speed Mach 1.85.
Service ceiling 52,000 ft. (15,850 m.).
Range with external tanks 3,000 miles (4,830 km.).

THE McDONNELL F4H.

The so far unnamed F4H is a twin-engined all-weather fighter-attack bomber which has been designed as a successor to the F3H Demon. Powered by two General Electric J79 engines, the F4H has been designed for Mach 2 speeds. The prototype XF4H flew for the first time on May 27, 1958. A development series of 23 F4H-1's has been ordered by the U.S. Navy.

The wings of the F4H are swept back at 45°; the outer sections have extended chord, giving a "dog-tooth" leading-edge, and considerable dihedral. The outboard half of the leading-edge of the inner wings can be drooped to supplement the large trailing-edge flaps, which are of the "blown" type. There are 23° of anhedral on the tailplane.

Normal armament of the F4H consists of four Sparrow III missiles on semi-submerged mountings under the fuselage. Alternatively, a GAM-77 Hound Dog stand-off bomb can be carried.

DIMENSIONS.—
Span 38 ft. 5 in. (11.7 m.).
Length 56 ft. (17.07 m.).

WEIGHT.—
Weight loaded over 40,000 lb. (18,150 kg.).

THE McDONNELL DEMON.
U.S. Navy designation: F3H.

The Demon is a single-seat single-jet swept-wing carrier-based fighter which is in production for the U.S. Navy.

The prototype XF3H-1 flew for the first time on August 7, 1951, and in August, 1952, the U.S. Navy placed an order for 150 F3H-1's, to be powered by the Westinghouse J40-W-22 turbojet engine.

During development the weight of the F3H-1 was increased from 22,000 lb. to 29,000 lb. (9,980 kg. to 13,150 kg.) to meet an all-purpose fighter requirement and a higher thrust engine, the J40-W-24, was specified in place of the original power-unit. This engine, unfortunately, did not come up to expectations, resulting in the F3H-1 being underpowered.

As a result, the last 90 of the original contract for 150 F3H-1's were re-ordered as F3H-2's with the Allison J71 engine. Of the 56 F3H-1's built, 21 early-production aircraft were retained for use as ground trainers and 29 were modified to take the J71 engine and converted to F3H-2 standard.

The Demon, which is of all-metal construction, has 45° sweptback thin wings and tail surfaces. The primary control system incorporates complete power actuation with separately controlled "feel" forces for the pilot. The wings have power-actuated leading-edge slats and trailing-edge slotted flaps, while speed brakes are fitted on the upper surface of each wing-root trailing-edge and on each side of the fuselage aft of the wings. The entire horizontal tailplane pivots at the fuselage to provide trim and maneouvring control throughout the entire speed range.

All combat fuel is carried in internal self-sealing tanks. Provision is also made for additional fuel in jettisonable external tanks and a retractable flight refuelling probe is carried in a fairing on the starboard side of the cockpit.

The pressurised cockpit, which is situated well forward for good forward and downward visibility, is provided with an ejection seat and jettisonable canopy.

The following are the currently known versions of the Demon :—

F3H-2N. Allison J71-A-2 turbojet engine (9,500 lb.=4,315 kg. s.t. dry) with afterburner. Night and all-weather fighter. First F3H-2 production version. Armament consists of four 20 mm. cannon and various types of external stores, including the Sidewinder Mach 2 infra-red homing missile and nuclear weapons.



The McDonnell F3H-2N Demon (Allison J71 turbojet engine with afterburner). (*Warren Bodie*).



The McDonnell F3H-2M Demon (Allison J71 turbojet engine with afterburner). (*Clay Janssen*).

F3H-2M. Day fighter missile carrier version armed with four 20 mm. cannon and four Sparrow III supersonic beam-riding missiles.

F3H-2P. Photographic reconnaissance version.

DIMENSIONS.—
Span 35 ft. 4 in. (10.7 m.).
Length 58 ft. 11 in. (17.9 m.).
Height 14 ft. 7 in. (4.45 m.).

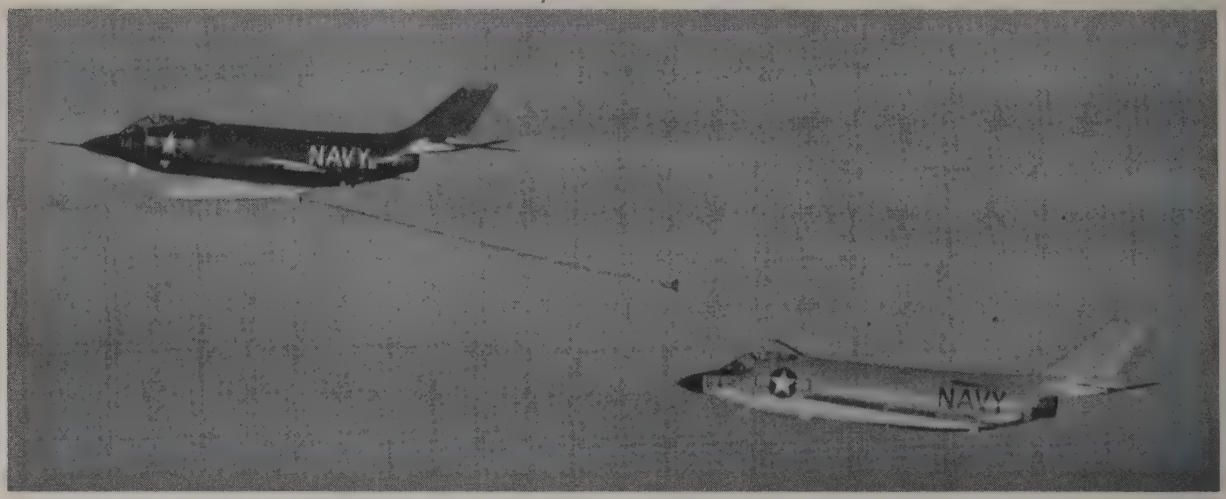
THE McDONNELL MODEL 120.

First flown in 1958, the Model 120 is a lightweight single-seat helicopter designed for flying crane duties. It is powered by three AiResearch GTC-85-35 turbo-compressors which supply compressed air to pressure-jets at the tips of the three-blade rotor. The aircraft can maintain height on any two engines.

DIMENSIONS.—
Not available.

WEIGHTS.—
Weight empty 2,400 lb. (1,090 kg.).
Payload 3,900 lb. (1,770 kg.).

PERFORMANCE.—
Range with full load 80 miles (130 km.).



A McDonnell F3H-2N about to be refuelled by "buddy" system by another F3H-2N.

McKINNIE

McKINNIE AIRCRAFT COMPANY, INC.

HEAD OFFICE AND WORKS: FARGO, NORTH DAKOTA.

President and Chief Engineer: James McKinnie.

Vice-President: William McKinnie.

Secretary: A. I. Johnson.

McKinnie Aircraft Co., Inc., an affiliate of Transocean Air Lines, was formed in 1947 to develop a new and simplified method of airframe design and construction.

The prototype of its first all-metal aircraft, the McKinnie 165, made its first flight on August 10, 1952, and this aircraft is now being rebuilt with a tricycle type landing gear.

McKinnie have also developed a simple modification kit for the Ryan Navion light aeroplane, consisting of wing root fairings which increase the cruising speed by 10-11 m.p.h. (16-17.7 km.h.) and give improved climb and glide characteristics. This modification has C.A.A. approval, as have the wing-tip fuel tanks for the Navion which the company has also produced.

THE McKINNIE 165.

McKinnie are re-designing their Model 165 two-seat light monoplane to have a tricycle type landing gear. A full description of the standard version, with 165 h.p. Franklin 6A4-165-B3 engine and tail-wheel landing gear, has appeared in earlier editions of "All the World's Aircraft."

McKINNON

McKINNON ENTERPRISES.

HEAD OFFICE AND WORKS: ROUTE 1, BOX 188, SANDY, OREGON.

Owner and Manager: A. G. McKinnon.

McKinnon-Hickman Company (now McKinnon Enterprises) entered the aircraft conversion field in 1953 when it undertook the conversion of the Grumman Widgeon twin-engined light amphibian into an executive aircraft. The success of this conversion has led to the development and manufacture of a larger four-engined amphibian, a conversion of the Grumman Goose. Brief details of these two aircraft follow:—

THE McKINNON SUPER WIDGEON.

Conversion of the Grumman Widgeon, which was originally powered by two 200 h.p. Ranger six-cylinder in-line inverted engines, into a higher-powered executive amphibian called for hull and landing-gear modifications to permit an all-up weight (land and water) of 5,500 lb. (2,500 kg.); the installation of two 270 or 295 h.p. Lycoming flat-six engines driving Hartzell three-blade airscrews; extra tanks in the outer wings to increase the capacity from 108 to 154 U.S. gallons (408 to 582 litres); and the fitting of a new instrument panel and a 24-volt electrical system.

The cabin was arranged to accommodate a pilot, co-pilot and three passengers, with provision for an extra seat when an escape hatch was installed. Some fifty Grumman G-44 and G-44A Widgeons, as well as a number of unsold French-built SCAN-30's (Grumman Widgeon licence) imported from France, were converted into Super Widgeons.

DIMENSIONS.—
Span 40 ft. (12.19 m.).
Length 31 ft. 1 in. (9.47 m.).
Height 11 ft. 5 in. (3.48 m.).

WEIGHT.—
Loaded 5,500 lb. (2,500 kg.).

PERFORMANCE.—
Max. speed 185 m.p.h. (296 km.h.).

Cruising speed (75% power) 170 m.p.h. (272 km.h.).
Landing speed 62 m.p.h. (99.2 km.h.).
Initial rate of climb 1,750 ft./min. (534 m./min.).
Service ceiling 18,000 ft. (5,490 m.).
Single-engine ceiling 5,000 ft. (1,525 m.).
Range 1,000 miles (1,600 km.).
Take-off (land) 600 ft. (183 m.).
Take-off (water) 10 sec.

THE McKINNON G-21-C GOOSE.

The Goose conversion is on generally similar lines to that of the Widgeon except that the two 450 h.p. Pratt & Whitney R-985 radial engines are replaced by four 340 h.p. Lycoming GSO-480-B2D6 flat-six air-cooled geared and supercharged engines driving constant-speed and reversible airscrews. The internal fuel capacity is increased from 220 to 450 U.S. gallons (833 to 1,700 litres). Other modifications include the fitting of retractable wing-tip floats, extended radar nose, dorsal fin, one-piece windscreen and a 24-volt electrical system. Landing-gear and wing-tip float retraction, flaps and airscrew pitch are all electrically-operated.

The cabin, which has been provided with larger windows, can be arranged to accommodate from eight to twelve persons, including pilot and co-pilot.



The McKinnon G-21-C Goose (four Lycoming GSO-480 engines).

DIMENSIONS.—
Span (over tip floats) 53 ft. (16.15 m.).
Length 40 ft. 4 in. (12.30 m.).
Height (on wheels) 15 ft. (4.57 m.).

WEIGHTS.—
Weight empty 8,190 lb. (3,720 kg.).
Weight loaded 12,000 lb. (5,450 kg.).

PERFORMANCE.—
Cruising speeds 225 m.p.h. (360 km.h.).
Landing speed 60 m.p.h. (96 km.h.).
Normal range 1,500 miles (2,410 km.).

MARTIN

THE MARTIN COMPANY.

HEAD OFFICE AND BALTIMORE DIVISION: MIDDLE RIVER, BALTIMORE 3, MARYLAND.

OTHER DIVISIONS: COCOA BEACH, FLORIDA; ORLANDO, FLORIDA; DENVER, COLORADO.

Established: 1909.

Chairman of the Board and President: George M. Bunker.

Executive Vice-President: W. B. Bergen.

Vice-President: Howard W. Merrill.

Vice-President, Industrial Relations: D. W. Siemon.

Vice-President, Sales and Service: Jess W. Sweetser.

Vice-President, Engineering: G. S. Trimble, Jr.

Vice-President and General Manager (Orlando): E. G. Uhl.

Vice-President and General Manager (Denver): A. L. Varrieur.

Vice-President, Manufacturing: G. T. Willey.

Vice-President and Controller: E. R. Uhlig.

Secretary and Treasurer: W. L. Lucas.

During 1957-58, Martin expanded the facilities of its Denver and Orlando Divisions and created another new Division in Florida to speed arrangements for launching its Vanguard earth-satellite rocket and Titan intercontinental ballistic missile. The company's official name was changed from "The Glenn L. Martin Company" to "The Martin Company" early in 1957, in keeping with the current industrial trend toward shorter names.

Production of the B-57E target tug was completed during 1957; but flight tests of the P6M SeaMaster flying boat were resumed early in 1958. Martin is also modernising the power plants, electrical and electronic systems of 80 early P5M Marlins for the U.S. Navy, and is adding magnetic airborne detection gear to these aircraft to increase their efficiency on anti-submarine patrol and air-sea rescue operations.

In Baltimore, Martin continued production of two new versions of the Matador surface-to-surface missile for the U.S.A.F. These are the TM-61C Matador, which has replaced the earlier TM-61A in service in the United States and overseas, and the TM-76 (ex TM-61B) Mace, which has folding wings and the ability to make either high or low level attacks. By mid-1957, the company had delivered 1,000 Matador/Mace missiles, and had also developed drag parachutes and other devices for recovery of Matadors used as target or test drones.

At Denver, where Martin is developing the Titan ICBM for the U.S.A.F., work was shifted from interim facilities to the permanent plant about 20 miles south-west of the city. Since manufacturing, assembly and testing operations can all be carried out at this division, it represents the first wholly-integrated missile facility in the United States. The first Titan launching was expected to take place late in 1958.

In Orlando, Martin began production of the Lacrosse surface-to-surface missile for the U.S. Army and the air-to-surface Bullpup for the U.S. Navy, together with the Missile Master, an electronic system for co-ordinating Nike and Hawk anti-aircraft batteries. In January, 1958, this Division began operation in its new permanent plant, which has a floor area of 500,000 sq. ft.

Details of all Martin missiles and the Vanguard research rocket will be found in the "Guided Missiles" section of this volume.

The Martin subsidiary RIAS, Inc. (Research Institute for Advanced Study), which was formed in 1955 to carry on basic studies in science, has developed, under contract from the National Science Foundation, instrumentation that will be carried in an earth-satellite to measure the heavy cosmic ray flux outside the densest part of the atmosphere.

In early 1958, total employment at all Divisions was about 27,000.

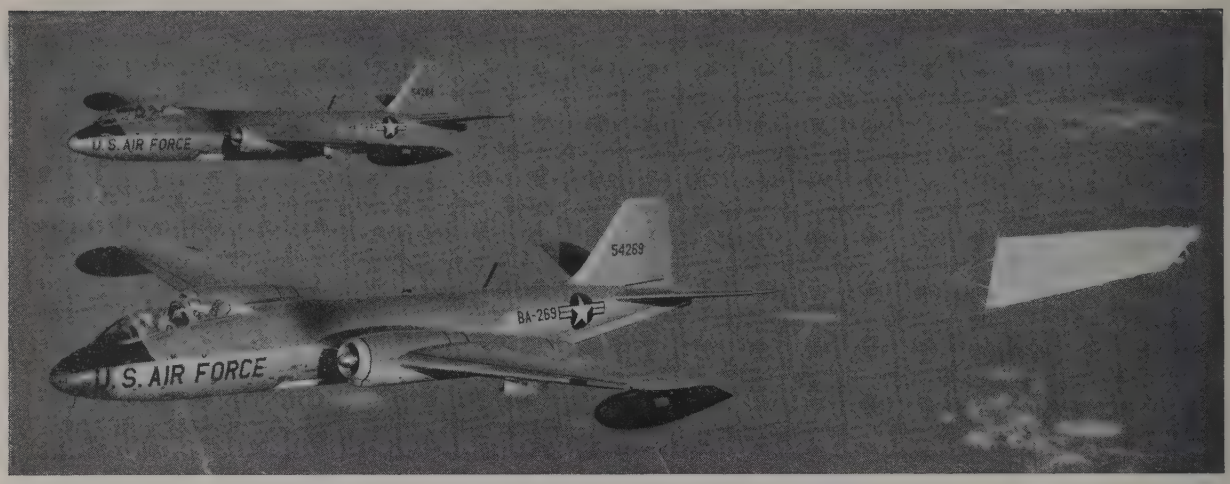
THE MARTIN MODEL 272.
U.S.A.F. designation: B-57.

The Martin company has built under licence versions of the English Electric Canberra for the U.S.A.F. The basic American version is powered by two Wright J65 turbojet engines.

In order to convert the Canberra to fulfil its U.S.A.F. missions, as well as to adapt it to American production methods, a considerable amount of re-design was undertaken by the Martin Company.



The Martin B-57B Tactical Bomber and Night Intruder (two Wright J65 turbojet engines).



Two Martin B-57E High-speed Target Tugs, one with a target streamed.

A Martin-developed feature introduced into the B-57 is a pre-loaded revolving bomb-bay door which rotates through 180 degrees just before the bombs are released, leaving no excrescences to reduce speed on the bombing run.

The following versions of the B-57 have been built :—

B-57A. Two Wright J65-W-1 turbojet engines (7,220 lb.=3,280 kg. s.t. each). Pre-production model externally similar to the British Canberra but incorporating many internal changes. Crew of two—pilot and navigator/radar operator/bombardier. First B-57A flew for the first time on July 20, 1953.

RB-57A. Reconnaissance version of B-57A. First RB-57A delivered to U.S.A.F. in March, 1954.

B-57B. Two Wright J65-W-5 engines (7.220 lb.=3,275 kg. s.t. each). Night intruder or tactical bomber. Crew of two, pilot and radar operator/navigator/bombardier, in tandem beneath continuous jettisonable canopy. Ejector-type seats. Improved bullet-proof windscreen with anti-icing and de-misting. Hydraulically-operated speed brakes added to rear fuselage. These move in co-ordination with "finger" type brakes on each wing. Armament consists of eight wing-mounted .50 in. machine-guns or four 20 mm. cannon. Four Napalm tanks in addition to eight 5-in. HVAR rockets may be carried on pylons under wings. Other stores may be carried on revolving bomb-bay door. Gross weight over 50,000 lb. (22,700 kg.). Maximum speed over 600 m.p.h. (960 km.h.), ceiling over 45,000 ft. (13,725 m.), and range more than 2,000 miles (3,220 km.). First B-57B flew for the first time on June 28, 1954.

B-57C. Basically similar to B-57B, but with dual controls so that it can perform the additional rôle of conversion training. For instrument training, for giving piston-engine pilots experience in jet operation or for giving single-engine fighter pilots multi-jet experience. The first B-57C flew on December 30, 1954.

B-57D. High-altitude version, with two 10,000 lb. (4,536 kg.) s.t. Pratt & Whitney J57 turbojet engines and greatly-increased span. Originally believed to be a flying test-bed, this version is now reported to be in service with the U.S.A.F. in Japan as the RB-57D highly-classified reconnaissance aircraft.

B-57E. Basically similar to B-57B but for dual service as tactical bomber and high-speed target tug. Capable of towing a wide variety of targets, four of which are normally carried in external containers on each flight. Conversion to bomber involves simply removal of the cockpit towing controls, external target containers and the internal cable reels and fittings which are normally carried on the rotary bomb-door. Intended to provide both air-to-air and ground-to-air firing practice at high altitudes.

DIMENSIONS.—
Span 64 ft. (19.5 m.).
Length 65 ft. 6 in. (19.9 m.).
Height 16 ft. (4.88 m.).

THE MARTIN MODEL 275 SEAMASTER.
U.S. Navy designation: P6M.

The SeaMaster is a four-jet swept-wing high-performance flying-boat of advanced design. Its two primary functions will be mine-laying and photographic reconnaissance but it will also be able to undertake other combat tasks, and remain in operation—in the air or afloat in waves up to 6 ft. (1.83 m.) high—for long periods of time.

A special beaching vehicle has been developed for the SeaMaster. This is moored unattended in the water, and the pilot has only to taxi between two floats to secure the vehicle to the aircraft's hull, after which the aircraft can be taxied out of the water under its own power. This beaching vehicle can be carried by the SeaMaster, and air-transportable dry dock and servicing dock facilities are also being built by Martin under a separate Navy contract.

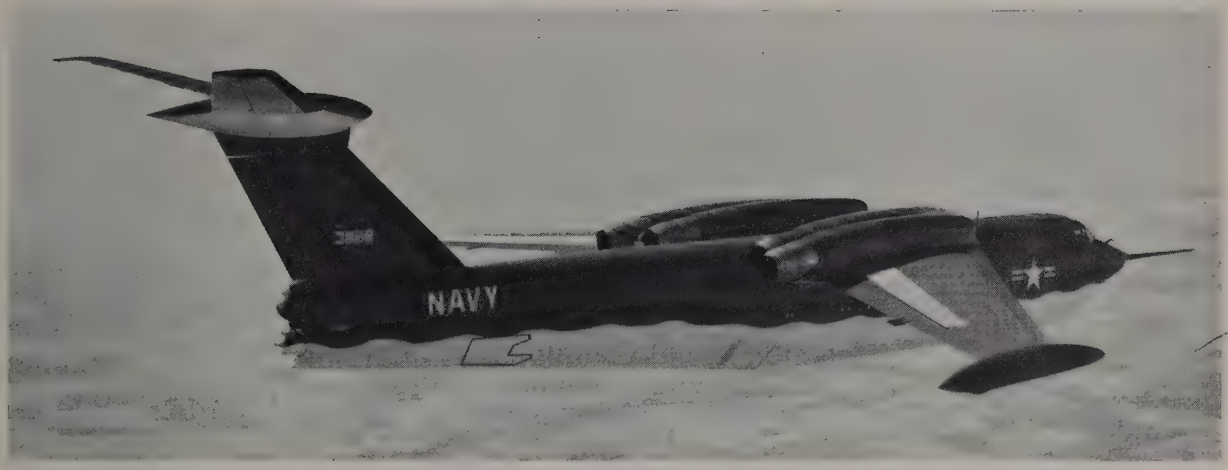
The following versions have been announced :—

XP6M-1. Two prototypes, first flown July 14, 1955 and May 18, 1956 respectively. Both lost in flying accidents attributed to faults in the tail and tail-plane-actuating mechanism.

YP6M-1. Six pre-production aircraft, powered like the prototypes with four Allison J71 turbojets. Revised hydraulic flying control system. Modified tail fin fairing. Redesigned engine air intakes. Engine nacelles splayed outward to carry exhaust gases away from rear fuselage. First YP6M-1 flew on January 20, 1958.



The Martin YP6M-1 SeaMaster Flying-boat (four Allison J71 turbojet engines and afterburners).



The Martin YP6M-1 SeaMaster Flying-boat (four Allison J71 turbojet engines and afterburners).

P6M-2. An order for 24 of this version, with more powerful Pratt & Whitney J75 turbojets, was placed in August, 1956, but was reduced to 18 aircraft in 1957.

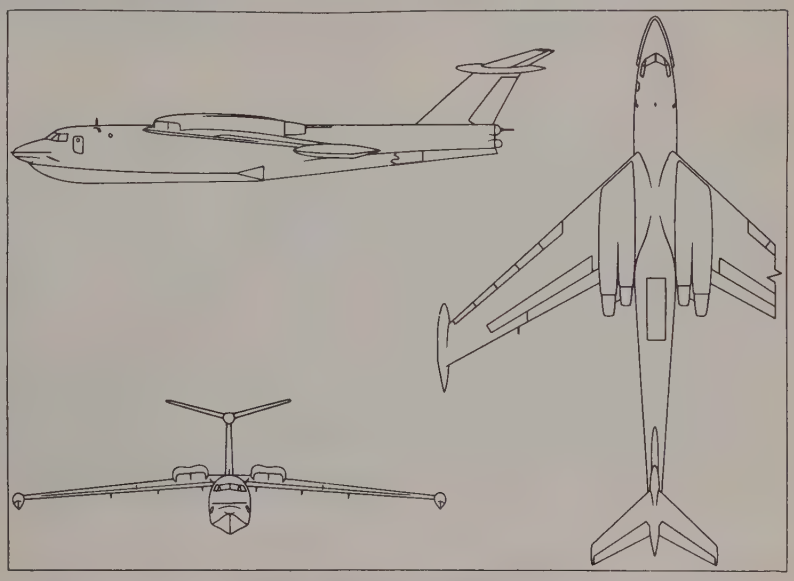
A special type of probe and drogue flight refuelling system is being developed for the P6M by Flight Refueling, Inc. This equipment will fit on the rotary mine-door and will enable the aircraft to transfer nearly 10,000 U.S. gallons (37,855 litres) of fuel during a single operation. The P6M will also be equipped to receive fuel in this way.

The following details refer specifically to the YP6M-1, but are expected to be generally applicable to later versions.

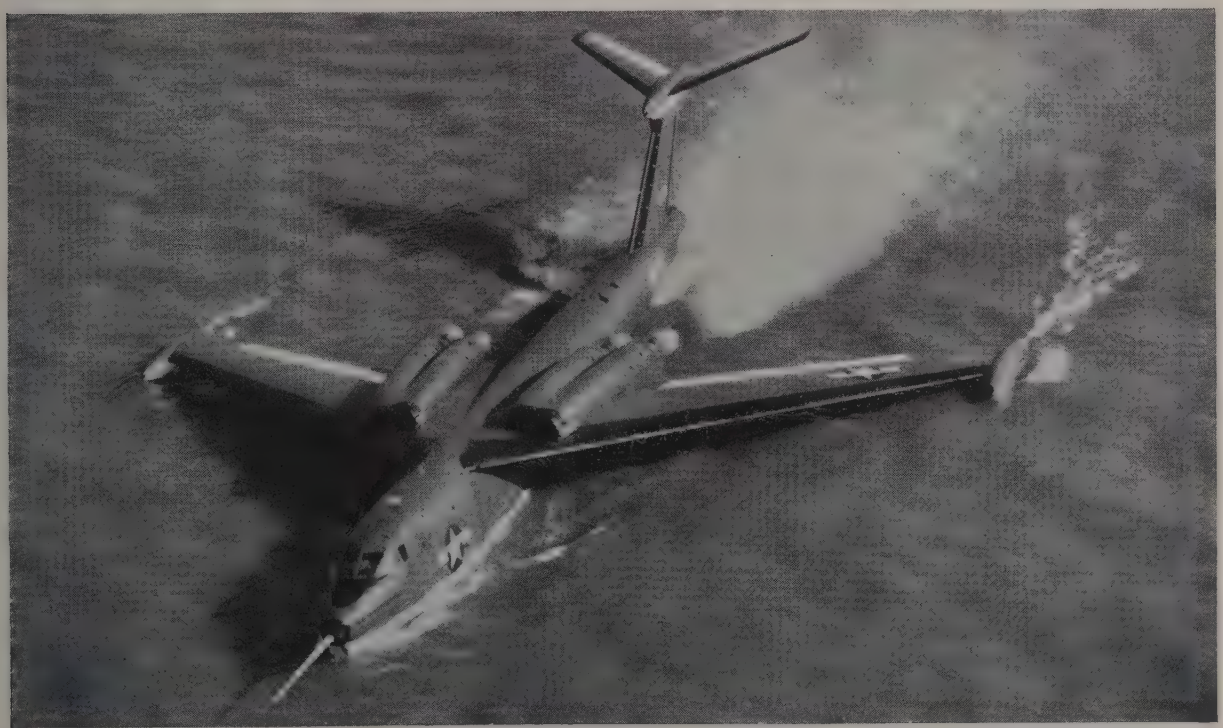
TYPE.—Four-jet multi-rôle Military flying boat.

WINGS.—Cantilever high-wing monoplane. Combination of sharp sweep-back and anhedral brings wing-tips so close to the water when the aircraft is at rest that the floats can be fixed permanently to the wing-tips. Gross wing area 1,900 sq. ft. (176.5 m.²).

HULL.—All-metal semi-monocoque structure of high length/beam ratio. Single faired Vee-step. Martin-developed hydroflaps on both sides of the afterbody serve as water rudders when opened individually or as water brake when extended together. Maximum beam 10 ft. (3.05 m.).



The Martin XP6M-1 SeaMaster.



The Martin YP6M-1 SeaMaster Flying-boat. This view shows the splaying-out of the engine nacelles introduced in this version.



The Martin P5M-1 Marlin Flying-boat (two 3,250 h.p. Wright Turbo Compound engines).

TAIL UNIT.—Cantilever monoplane structure, with tailplane mounted at the tip of the fin. All units sharply swept-back. Total area fin and rudder 213 sq. ft. (19.79 m.²).

POWER PLANT.—Four Allison J71 turbojet engines with afterburners (XP6M-1 and YP6M-1) or four Pratt & Whitney J75 turbojets (P6M-2). The engines are mounted in pairs in nacelles on the upper wing surfaces. The upper portions of the nacelles have hinged panels extending the full length and width of the engines to permit engine changes to be made while the aircraft is afloat.

ACCOMMODATION.—Crew of four—pilot, co-pilot, navigator/minelayer, and radio and armament defence operator. The interior arrangement of the hull includes, from nose to tail, a bow radome enclosing a radar scanner; main deck with pilot compartment; entrance compartment (with entrance door on the port side) which also serves for stowage for anchor and mooring gear; flight deck compartment for crew members; and a pressure lock for in-flight access to unpressurised areas. Beneath the flight deck is the electrical and electronics compartment. To the rear of the pressurised area is the mine-bay compartment, which includes a portion of the main wing in the upper section, fuel tanks, air conditioning and anti-icing equipment and tracks with a small trolley on which crew members pull themselves forward or aft above the store of mines or other equipment below. Aft of the mine-bay is the mine-loading compartment which extends the full height of the hull. Mines and other stores are loaded into this compartment through a large hatch in the top of the hull. Rear compartments house electronic equipment for the tail turret and the auxiliary power-plant. The flight deck can be pressurised to maintain a cabin altitude of 21,000 ft. (6,400 m.) against a true altitude of 50,000 ft. (15,250 m.). Ejection seats for all crew members. The mine-bay is fitted with a water-tight rotary mine door on which mines, stores or a camera pod can be installed while the aircraft is afloat or on its beaching-gear. Ashore, the mine-door can be removed completely and replaced by another which has been pre-loaded. Watertightness is assured by a self-sealing rubber pneumatic tube system.

DIMENSIONS.—
Span 100 ft. (30.48 m.).
Length 134 ft. (40.84 m.).
Height 31 ft. (9.45 m.).

WEIGHT.—
Payload 30,000 lb. (13,608 kg.).
Weight loaded 160,000 lb. (72,570 kg.).

PERFORMANCE.—
Max. speed over 600 m.p.h. (960 km.h.).
Normal cruising height 40,000 ft. (12,200 m.).
Combat radius on internal tankage 1,500 miles (2,415 km.).

THE MARTIN MODEL 237 MARLIN.
U.S. Navy designation: P5M.

The P5M was the first twin-engined flying-boat to be developed for the U.S. Navy for anti-submarine warfare since the war.

Two versions of the Marlin exist. These are identified as follows :—

P5M-1. Two 3,250 h.p. Wright R-3350-30WA Turbo Compound engines. First production version. Low tailplane. First production Marlin flew for the first time on June 22, 1951, and the first P5M-1 was delivered to the U.S. Navy in December, 1951. Deliveries continued throughout 1953 and into 1954. A number of ASR versions of the P5M-1 were delivered to the U.S. Coast Guard in the Autumn of 1953.

Under a programme announced in April, 1957, eighty P5M-1 Marlins are being modernised, by the addition of magnetic airborne detection (MAD) equipment and improvements in the power-plant systems, electrical and electronic systems. The programme will extend through 1959.

P5M-2. Two 3,400 h.p. Wright R-3350-32W Turbo Compound engines. Development of P5M-1. Chief external difference is the new "T" tail with the horizontal surfaces on top of the fin. Also has a lower bow chine line to reduce spray damage to the airscrews, the latest ASW electronic equipment, and a re-arrangement of much of the interior equipment for greater operational comfort and convenience. In production. The first P5M-2 first flew in August, 1953. First P5M-2 delivered to U.S. Navy on June 23, 1954.

The general structure of the P5M-1 and P5M-2 is similar. The description below applies primarily to the P5M-2 except where indicated.

TYPE.—Twin-engined Anti-Submarine Warfare flying-boat.

WINGS.—Gull-wing cantilever monoplane. Wing section NACA 23020 at root, NACA 4412 at tip. Dihedral 16° inner gull section, 3° outboard of nacelles. Gull-wing centre-section integral with hull, outer panels and tips removable. Goodrich de-icing boots on leading-edges. All-metal three-spar box structure. Conventional trailing-edge ailerons have metal D-spar



The Martin P5M-2 Marlin Flying-boat (two 3,400 h.p. Wright Turbo Compound engines). (*Gordon Williams*).

leading-edges, metal ribs and fabric covering. All-metal spoiler ailerons operating in conjunction with the conventional ailerons to counteract any rolling tendencies that might develop at take-off or alighting in rough water, are located inboard of main ailerons in line of rear spar. All-metal trailing-edge flaps between ailerons and nacelles and nacelles and hull. Total conventional aileron area (including tabs) aft of hinge line 60.8 sq. ft. (5.65 m.²). Total spoiler aileron area 46.49 sq. ft. (4.32 m.²). Total flap area 204.3 sq. ft. (18.97 m.²). Gross wing area (including 103.2 sq. ft. = 9.59 m.² of hull) 1,406.33 sq. ft. (130.65 m.²).

HULL.—All-metal semi-monocoque structure. Single faired V-type step and long planing afterbody. New lower bow chine line, as compared with P5M-1, results in reduction of spray height and permits take-off in heavier seas at greater A.U.W. Martin-developed hydraulically-operated hydro-flaps one on each side of after hull bottom serve as water rudders when operated individually or as water brake or sea anchor when both extended together. All-metal wing-tip stabilising floats.

TAIL UNIT (P5M-2).—Cantilever all-metal T-type structure. Areas: fin, including 33 sq. ft. (3.07 m.²) of dorsal fin and 16.7 sq. ft. (1.55 m.²) of contained rudder balance 169.31 sq. ft. (15.73 m.²), rudder, aft of hinge line 47.65 sq. ft. (4.43 m.²), tailplane including 32.02 sq. ft. (2.97 m.²) of contained elevator balance 172.08 sq. ft. (15.99 m.²), elevators, aft of hinge line 86.4 sq. ft. (8.03 m.²).

POWER PLANT.—Two 3,250 h.p. Wright R-3350-30WA (P5M-1) or 3,400 h.p. R-3350-32W (P5M-2) Turbo Compound engines. Hamilton Standard airscrews. Fuel tanks in hull and centre wing section are of self-sealing Mareng type. Two non-self-sealing auxiliary tanks outboard of service tanks, one in each wing panel. Provision for jettisoning fuel and for purging interior of auxiliary tanks and spaces surrounding hull tanks with carbon-dioxide for combat protection. Two droppable tanks can be installed, one in each nacelle bomb-bay. Total fuel capacity (P5M-1 and P5M-2) 3,975 U.S. gallons (15,047 litres).

ACCOMMODATION.—Crew of seven. Details of interior accommodation not available.

ARMAMENT.—Defensive armament in tail-turret. Bomb-bays in engine nacelles for various types of offensive stores.

EQUIPMENT.—Magnetic airborne detector (AN/ASQ-8 MAD) unit in tubular plastic fairing extending aft from horizontal-vertical tail juncture. AN/APS-44A radar scanner in nose radome. Camera installation for damage estimation by day or by night in streamline pod which can be attached to outside of hull. Hoisting points on centre-line of hull at wings for hoisting craft aboard seaplane tender at 60,000 lb. (27,240 kg.) gross weight. Beaching-gear to support gross weight of 78,500 lb. (35,640 kg.) can be stowed aboard dis-assembled.

DIMENSIONS (P5M-1).—
Span 118 ft. (35.97 m.).
Length 94 ft. 9 in. (28.88 m.).
Height 38 ft. 4 in. (11.68 m.).

DIMENSIONS (P5M-2).—
Span 118 ft. 2¼ in. (36.0 m.).
Length 101 ft. 9⅛ in. (31.03 m.).
Height 33 ft. (10.06 m.).

WEIGHTS (P5M-1, A.S.W. mission).
Weight empty 48,214 lb. (21,869 kg.).
Weight loaded 74,166 lb. (33,641 kg.).

WEIGHTS (P5M-2, A.S.W. mission).—
Weight empty 49,480 lb. (22,444 kg.).
Weight loaded 74,442 lb. (33,767 kg.).

PERFORMANCE.—
Max. speed at S/L. (P5M-1) 237 m.p.h. (381 km.h.).
Max. speed at S/L. (P5M-2) 245 m.p.h. (394 km.h.).
Max. diving speed 303 m.p.h. (487 km.h.).
Alighting speed (at 54,600 lb. = 24,766 kg. A.U.W.) 93 m.p.h. (150 km.h.).
Range (A.S.W. mission, with 2,809 U.S. gallons = 10,633 litres fuel) 2,050 miles (3,300 km.).
Ferry range (P5M-2, full fuel) 3,000 miles (4,825 km.).

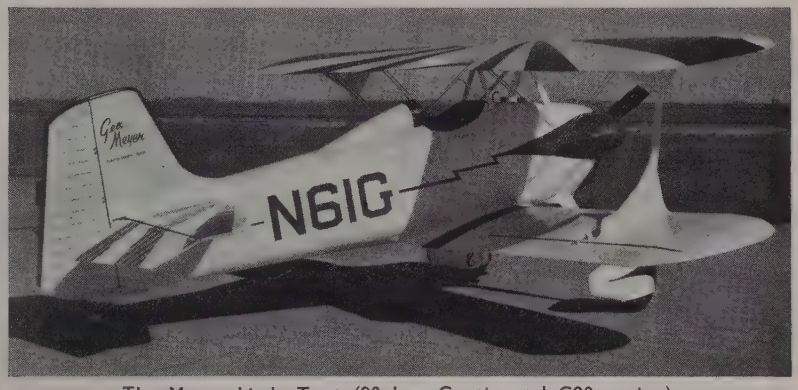
MEYER

MEYER AIRCRAFT.

ADDRESS: 1846 HAWTHORNE, CORPUS CHRISTI, TEXAS.

Meyer Aircraft was formed by Mr. George W. Meyer, to market plans for the construction by amateurs of a small, fully-aerobatic biplane of his own design, known as the Little Toot.

The prototype, to which the data below apply, has a metal monocoque fuselage and metal tail surfaces; but the plans give details also of an alternative and easier method of making these components, using conventional metal tube construction, with plywood fuselage bulkheads, wood stringers and fabric covering.



The Meyer Little Toot (90 h.p. Continental C90 engine).

THE MEYER LITTLE TOOT.

TYPE.—Single-seat Sporting biplane.

WINGS.—Braced biplane type, with single interplane strut each side and two N-type strut assemblies supporting top wing above fuselage. NACA 2212 wing section. Sweepback 8° on top wing only. Dihedral 0° on top wing, 2½° on lower wing. Chord 3 ft. 6 in. (1.07 m.). All-wood two-spar structure with fabric covering. Ailerons on lower wing only. Wing area 123 sq. ft. (11.43 m.²).

FUSELAGE.—All-metal structure, with metal covered tubular construction in forward fuselage and metal monocoque rear fuselage.

TAIL UNIT.—Cantilever monoplane type of all-metal construction. Trim tab in port elevator. Areas: fin 4.66 sq. ft. (0.43 m.²), rudder 3.47 sq. ft. (0.32 m.²), tailplane 10.5 sq. ft. (0.98 m.²), elevator 7.25 sq. ft. (0.67 m.²), tailplane span 7 ft. (2.13 m.).

LANDING GEAR.—Non-retractable tail-wheel type. Cantilever spring steel main legs of type fitted to Cessna 120 aircraft. Wheel spats. Steerable tail-wheel. Wheel track 6 ft. (1.83 m.).

POWER PLANT.—One 90 h.p. Continental four-cylinder horizontally-opposed air-cooled engine, driving two-blade fixed-pitch airscrew. Provision for alternative four-cylinder engines up to 150 h.p. Fuel capacity 18 U.S. gallons (68 litres). Oil capacity 6 U.S. quarts (5.7 litres).

ACCOMMODATION.—Single seat open cockpit. Baggage space aft of seat.

DIMENSIONS.—
Span (both) 19 ft. 0 in. (5.79 m.).
Length 16 ft. 6 in. (5.03 m.).
Height 7 ft. 0 in. (2.13 m.).

WEIGHTS AND LOADINGS.—
Weight empty 914 lb. (415 kg.).
Weight loaded 1,230 lb. (558 kg.).
Wing loading 10 lb./sq. ft. (48.8 kg./m.²).
Power loading 13.7 lb./h.p. (6.22 kg./h.p.).

PERFORMANCE.
Max. speed 127 m.p.h. (204 km.h.).
Cruising speed 110 m.p.h. (177 km.h.).
Stalling speed 55 m.p.h. (88.5 km.h.).
Rate of climb at S/L. 1,000 ft./min. (305 m./min.).
Climb to 5,000 ft. (1,525 m.) 5 min. 20 sec.
Service ceiling 16,500 ft. (5,030 m.).

MOONEY

MOONEY AIRCRAFT INC.

HEAD OFFICE AND WORKS: LOUIS SCHREINER FIELD, KERRVILLE, TEXAS.

President and Chairman of the Board: Hal F. Rachal.

Executive Vice-President and Sales Manager: Norman F. Hoffman.

Secretary-Treasurer: E. B. Hunnicutt.

General Manager: E. Herbert Andersen, Jr.

Acting Chief Engineer: John W. Taylor.

The Mooney Aircraft, Inc. was formed to build the M-18 Mite single-seat light monoplane, which was designed for extremely economical operation and has been described fully in earlier editions of "All the World's Aircraft."

Its current products are the Mk. 20 and Mk. 20A four-seat cabin monoplanes described below.

THE MOONEY MARK 22.

Completed early in 1958, the Mark 22 is a twin-engined low-wing cabin monoplane of conventional layout, with a tricycle landing gear. The prototype consists of a Mark 20 fuselage with new wings and the addition of a large dorsal fin. It is powered by two 150 h.p. Lycoming engines.

THE MOONEY MARK 20.

TYPE.—Four-seat cabin monoplane.

WINGS.—Low-wing cantilever monoplane. NACA laminar-flow wing section. Laminated single-piece single-spar structure with plywood torsion-box covering. Manually-operated three-position narrow-chord slotted flaps over 70 per cent. of trailing-edge. Sealed gap differentially-operated ailerons. Total area of ailerons 11.1 sq. ft. (1.03 m.²). Total area of flaps 17.2 sq. ft. (1.6 m.²). Gross wing area 166.9 sq. ft. (15.50 m.²).

FUSELAGE.—Composite all-metal structure. Cabin section is of welded steel-tube with sheet aluminium-alloy covering. Rear section is of aluminium-alloy with internal formers and stringers.

TAIL UNIT.—Cantilever monoplane type. Variable-incidence tailplane and fin move together for trim control. Both are single spar structures with plywood torsion-box leading-edge and plywood covering aft. All control surfaces have welded steel-tube frames with fabric covering. Areas: tailplane 21.5 sq. ft. (2 m.²), elevators 12 sq. ft. (1.11 m.²), fin 5 sq. ft. (.46 m.²), rudder 7.9 sq. ft. (.73 m.²). Tailplane span 11 ft. 8 in. (3.55 m.).

LANDING GEAR.—Retractable nose-wheel type. Rubber-in-compression with rebound control shock-absorbers. Steerable nose-wheel. Hand retraction by lever in cockpit between front seats. Hydraulic brakes on main wheels. Track: 9 ft. 2 in. (2.79 m.). Wheelbase: 5 ft. $6\frac{9}{16}$ in. (1.68 m.).

POWER PLANT.—One 150 h.p. Lycoming O-320 four-cylinder horizontally-opposed air-cooled engine. Hartzell two-blade all-metal constant-speed airscrew with Hamilton Standard governor. Diameter of airscrew 6 ft. 2 in. (1.88 m.). Fuel capacity 50 U.S. gallons (190 litres) in two 17½ gallon wing tanks and one 15 gallon reserve tank.

ACCOMMODATION.—Cabin seats four in two pairs, front pair with dual controls. Starboard front and rear seats removable for freight stowage. Single door on starboard side giving access to all seats. Baggage compartment behind cabin with access from cabin or through outside door.

DIMENSIONS.—
Span 35 ft. (10.67 m.).
Length 23 ft. 2⅝ in. (7.07 m.).
Height 8 ft. 3⅛ in. (2.52 m.).

WEIGHTS AND LOADINGS.—
Weight empty equipped 1,415 lb. (642 kg.).
Pilot and 3 passengers 680 lb. (310 kg.).
Fuel and oil 315 lb. (143 kg.).
Baggage 120 lb. (54 kg.).
Weight loaded 2,450 lb. (1,112 kg.).
Wing loading 14.67 lb./sq. ft. (70.36 kg./m.²).
Power loading 16.33 lb./h.p. (7.41 kg./h.p.).

PERFORMANCE (Standard airscrew).—
Max. speed at S/L. 171 m.p.h. (275 km.h.).
Max. cruise (75% power) 165 m.p.h. (265 km.h.) at 4,900 ft. (1,495 m.).
Economic cruise (55% power) 150 m.p.h. (240 km.h.) at 10,000 ft. (3,050 m.).
Landing speed (flaps at 50°) 57 m.p.h. (92 km.h.).
Rate of climb at S/L. 900 ft./min. (275 m. min.).
Service ceiling 17,200 ft. (5,240 m.).
Absolute ceiling over 20,000 ft. (6,100 m.)
Range at optimum cruise 600 miles (960 km.) in 4.6 hours.
Range at economic cruise 675 miles (1,080 km.) in 6 hours.
Take-off run 725 ft. (220 m.).
Landing run (flaps down) 575 ft. (175 m.).

THE MOONEY MARK 20A.

The Mk. 20A is identical to the Mk. 20 except that it is powered by a 180 h.p. Lycoming O-360 in place of the lower-powered O-320 engine.

DIMENSIONS AND WEIGHTS.—
As for Mk. 20.

PERFORMANCE.—
Max. speed at S/L 190 m.p.h. (304 km.h.).
Max. cruising speed (75% power) 180 m.p.h. (288 km.h.) at 7,500 ft. (2,290 m.).
Economic cruise (55% power) 165 m.p.h. (265 km.h.) at 10,000 ft. (3,050 m.).
Landing speed (flaps down) 57 m.p.h. (92 km.h.).
Rate of climb at S/L 1,150 ft./min. (350 m./min.).
Service ceiling 20,000 ft. (6,100 m.).
Absolute ceiling over 22,000 ft. (6,710 m.).
Range at max. cruise 630 miles (1,008 km.) at 7,500 ft. (2,290 m.).
Range at econ. cruise 760 miles (1,216 km.) at 10,000 ft. (3,050 m.).



The Mooney Mark 20 (150 h.p. Lycoming O-320 engine).

NAGLER

NAGLER HELICOPTER COMPANY, INC.

HEAD OFFICE AND WORKS: WESTCHESTER COUNTY AIRPORT, WHITE PLAINS, NEW YORK.
President: Bruno Nagler.
Vice-President: R. G. Anderson.
Secretary: Walter Duke.
Treasurer: Samuel Mandel.

This company has built and flown a single-seat experimental helicopter known as the Nagler Model NH-160 which embodies radically new principles of power transmission, in that the upper and lower rotors are driven directly through extension shafts by the crankcase and crankshaft respectively. This completely eliminates the need for transmissions, gearboxes, drive-belts, or other means of power delivery.

During powered flight, the lower rotor provides the primary driving force, while the upper rotor, through a conventional swashplate control system, primarily guides the aircraft and provides a counter-torque reaction for the lower rotor. Due to the fact that the lower rotor is the primary lifting surface, the upper rotor in effect becomes very lightly loaded, thus allowing it to operate at very low angles of attack.

The NH-160 flew for the first time in December, 1955 and is described hereafter.

THE NAGLER NH-160.

TYPE.—Single-seat Experimental helicopter.

ROTOR SYSTEM.—Two-blade upper rotor, driven directly by engine crankcase. Wooden blades, with spruce spar and plywood covering, attached to the crankcase extension shaft by a steel pin inserted through both flapping hinges. These are solid steel bars which are retained in the rotor cuff bearings by snap rings. The rotor cuff is attached to the blade by a series of bolts through the main spar of the blade. Area of each blade 6.02 sq. ft. (0.56 m.²). Disc area of upper rotor 323 sq. ft. (30 m.²). Three-blade lower rotor, mounted under engine, is of similar construction to the upper rotor and is attached to the crankshaft through a rigid see-saw hinge. It is the primary lifting surface, receiving a power input approximately five times that of the upper rotor. Torque balance between the two rotors is introduced aerodynamically and is automatically compensated for by the engine. Disc area of lower rotor 51.5 sq. ft. (4.79 m.²).

FUSELAGE.—Open welded steel-tube structure.

LANDING GEAR.—Fixed skid type. Track 7 ft. 6 in. (2.29 m.).

POWER PLANT.—One McCulloch Type 4318A four-cylinder horizontally-opposed air-cooled two-stroke engine, giving 72 h.p. at 4,000 r.p.m. Suspended in bearings which allow complete rotation.

ACCOMMODATION.—Open seat for pilot only.

DIMENSIONS.—
Upper rotor diameter 20 ft. 7 in. (6.27 m.).
Lower rotor diameter 8 ft. 1 in. (2.46 m.).
Overall length 21 ft. 11 in. (6.68 m.).
Length of fuselage 16 ft. (4.88 m.).
Overall width 7 ft. 7 in. (2.31 m.).
Height 7 ft. (2.13 m.).

WEIGHTS.—
Weight empty 500 lb. (227 kg.).
Weight loaded 660 lb. (300 kg.).

PERFORMANCE.—
No details available.



The Nagler NH-160 Helicopter (72 h.p. McCulloch engine).

NATIONAL

NATIONAL AIRCRAFT DIVISION OF AMERICAN AIRMOTIVE CORPORATION.

HEAD OFFICE AND WORKS: BUILDING 146, MIAMI INTERNATIONAL AIRPORT, MIAMI, FLORIDA.

The National Aircraft Division of American Airmotive Corporation manufactures an agricultural aircraft known as the NA-75, which consists of a modified Stearman Model 75 (Boeing Kaydet) fuselage, fitted with new high-lift wings of metal construction and dispersal equipment that permits instantaneous change-over from dust to spray.

The NA-75 is available as a complete aircraft. Alternatively, the new wings, a fuselage modification kit and the dust-spray equipment can be obtained individually for easy conversion of existing Stearmans.

The NA-75 has been in production as a complete aircraft for two years. The all-metal National high-lift wing has been on the market for over five years and more than 200 Stearmans have been converted to this wing, which permits loads of over 2,000 lb. (908 kg.) to be carried by the modified Stearman 75.

THE NATIONAL NA-75.

TYPE.—Single-seat Agricultural aircraft.

WINGS.—Single-bay unequal-span staggered biplane. Göttingen 398 wing section. Chord 5 ft. 5 in. (1.65 m.). Incidence (upper) 4°, (lower) 2°. Dihedral (upper) ½°, (lower) 1½°. All-metal stressed skin centre-section has all flight and engine instruments located in trailing edge and is carried above fuselage by splayed-out wire-braced streamline steel-tube struts. One original Stearman "N"-type streamline steel-tube interplane strut assembly on each side of fuselage, with chrome-molybdenum wire cutters on leading edge. Wings have all-metal structure, fabric-covered except for leading edges which are assembled in small sections for ease of replacement without disturbing fabric. Fabric is attached by clips. Metal ailerons and end-plates on all four wings. Wing area 338.26 sq. ft. (31.43 m.²).

FUSELAGE.—Rectangular welded chrome-molybdenum steel-tube structure, covered with quickly-removable metal panels.

TAIL UNIT.—Standard Stearman unit. Wire-braced monoplane type. Welded chrome-molybdenum steel-tube framework with fabric covering. Trim-tabs in each elevator. Chrome-molybdenum wire cutter on leading edge of fin.

LANDING GEAR.—Standard Stearman units. Divided cantilever type. Torque-resisting oleo-spring shock-absorbers enclosed in metal fairings. Wire-cutters on leading-edges of fairings. Double-action Servo brakes Steerable tail-wheel..

POWER PLANT.—One 220 h.p. Continental R-670, or 225 h.p. Lycoming R-680-B4 or 300 h.p. Lycoming R-680-E3, or 245 h.p. Jacobs R-755, or 300 h.p. Jacobs R-915, or 425 h.p. Wright R-975, or 450 h.p. Pratt & Whitney R-985 radial air-cooled engine on steel-tube mounting. Two-blade adjustable-pitch metal airscrew. Fuel tank in centre-section.

ACCOMMODATION.—One open cockpit, with crash pads forward of seat and around coaming.

EQUIPMENT.—Combination 31.7 cub. ft. (0.897 m.³) reinforced Fiberglas dust-spray hopper forward of cockpit with aerofoil-type dust spreader under fuselage and spray-booms along trailing-edge of lower wings. Provision for dumping load in 5 seconds. Spray pump and dust agitator engine-driven through variable-speed power take-off, controllable in flight.

DIMENSIONS.—
Span (upper) 33 ft. 0½ in. (10.07 m.).
Span (lower) 29 ft. 5 in. (8.97 m.).
Length 24 ft. 9 in. (7.54 m.).

WEIGHTS.—
Weight loaded 2,612-4,612 lb. (1,185-2,092 kg.) depending on engine and payload.

PERFORMANCE (220 h.p. R-670 engine).—
Stalling speed with 500 lb. (227 kg.) load 41 m.p.h. (66 km.h.).
Stalling speed with 1,250 lb. (567 kg.) load 55 m.p.h. (88.5 km.h.).
Rate of climb at S/L. with 500 lb. (227 kg.) load 660 ft./min. (200 m./min.).
Rate of climb at S/L. with 1,250 lb. (567 kg.) load 420 ft./min. (128 m./min.).
Take-off distance with 500 lb. (227 kg.) load 645 ft. (197 m.).



The National NA-75 Agricultural Biplane, based on the Stearman Model 75.

Take-off distance with 1,250 lb. (567 kg.) load 890 ft. (270 m.).

PERFORMANCE (450 h.p. R-985 engine).—
Stalling speed with 500 lb. (227 kg.) load 41 m.p.h. (66 km.h.).
Stalling speed with 1,250 lb. (567 kg.) load 55 m.p.h. (88.5 km.h.).
Rate of climb at S/L. with 500 lb. (227 kg.) load 1,110 ft./min. (338 m./min.).
Rate of climb at S/L. with 2,000 lb. (907 kg.) load 550 ft./min. (168 m./min.).
Take-off distance with 500 lb. (227 kg.) load 330 ft. (100 m.).
Take-off distance with 2,000 lb. (907 kg.) load 785 ft. (240 m.).

NORTH AMERICAN

NORTH AMERICAN AVIATION, INC.

HEAD OFFICE: INTERNATIONAL AIRPORT, LOS ANGELES 45, CAL.

AIRCRAFT PRODUCTION PLANTS: LOS ANGELES, CALIFORNIA, AND COLUMBUS, OHIO.

MISSILE DEVELOPMENT DIVISION: DOWNEY, CALIFORNIA.

ROCKETDYNE DIVISION: CANOGA PARK, CALIFORNIA AND NEOSHO, MISSOURI.

ATOMICS INTERNATIONAL DIVISION: CANOGA PARK, CALIFORNIA.

AUTONETICS DIVISION: DOWNEY, CALIFORNIA.

Chairman of the Board: J. H. Kindelberger.

President: J. L. Atwood.

Vice-President, Administration: J. S. Smithson.

Vice-President and Treasurer: R. A. Lambeth.

Vice-President, General Counsel: G. B. Brophy.

Vice-President, Engineering and Planning: L. L. Waite.

Vice-President, Military Relations: A. T. Burton.

Vice-President and Assistant to the President: L. R. Taylor.

Assistant to the President: W. H. Cann.

Secretary and Assistant Treasurer: S. G. Anspach.

Vice-President and General Manager of Atomics International Division: Dr. Chauncey Starr.

Vice-President and General Manager of Autonetics Division: J. R. Moore.

Vice-President and General Manager of Columbus Division: C. J. Gallant.

Vice-President and General Manager of Los Angeles Division: R. H. Rice.

Vice-President and General Manager of Missile Development Division: J. G. Beerer.

Vice-President and General Manager of Rocketdyne Division: S. K. Hoffman.

North American Aviation, Inc., was incorporated in Delaware in 1928 and from 1934 until 1945 was engaged solely in the design and manufacture of military aircraft. Manufacturing facilities were established at Inglewood, California, in 1935, where a modern production plant was erected on the Los Angeles Municipal (now International) Airport. Other facilities have since been acquired in the Los Angeles area.

The plant at Fresno, California, which North American had operated since 1951 as a modification centre, was closed in December, 1957, when its operations were transferred to the Los Angeles Division. As a result, the company's aircraft development, production and modification work is now concentrated in the Los Angeles and Columbus Divisions.

Production at Los Angeles continues to be concentrated on late models of the F-100 Super Sabre. This Division is also responsible for design and development of many other important projects, including the X-15 hypersonic piloted research aircraft, the Sabreliner combat readiness trainer and utility aircraft, the B-70 chemical-fuel bomber and the F-108 long-range interceptor. Contracts for the B-70 and F-108 were won against the most intense competition from other companies, as these aircraft are two of the most important in the U.S.A.F.'s future re-equipment programme.

Super Sabres are also in production at the Columbus Division, together with the FJ-4 Fury naval fighter. The last of 1,948 T-28 trainers was delivered from this Division in the autumn of 1957; but its place has already been taken by the T2J two-seat jet trainer, the first of which flew on January 31, 1958. The Columbus Division is also developing an important supersonic attack aircraft, the A3J, for the U.S. Navy.

Considerable modification work on versions of the F-86 Sabre continues at Los Angeles, which Division also provides support for the licence production of F-86K Sabres in Italy and F-86F Sabres in Japan. Other countries where the F-86 continues in production are Australia and Canada.

In addition, North American has technical assistance agreements with the Spanish CASA company, under which CASA is inspecting, overhauling and repairing F-86F Sabres of the Spanish Air Force and F-100D Super Sabres of the U.S. Air Forces in Europe.

Current activities of the North American Missile Development Division are described in the "Guided Missiles" section of this work.

Other Divisions include the Rocketdyne, Autonetics and Atomics International Divisions. Of these, the Rocketdyne Division is reponsible for all development, testing and production in the rocket engine category; the Atomics International Division has responsibility for all nuclear engineering and manufacture; and the Autonetics Division handles all development and production in the field of automatic navigation and control equipment.

Total employment in all North American Divisions at the end of the company's 1957 fiscal year exceeded 50,000.

THE NORTH AMERICAN X-15.

Following preliminary studies by the N.A.C.A. and an industry-wide design competition, North American was awarded in December, 1955 a U.S.A.F./U.S.N./N.A.C.A. contract for three prototypes of a manned research aircraft which will have a designed speed of at least Mach 7 and will be capable of reaching an altitude of at least 528,000 ft. (161,000 m.). Known as the X-15, this aircraft is being developed to obtain data particularly with regard to heating, stability, control and the problems of re-entry into the atmosphere. All design details and problems encountered during development are being made available immediately to the entire U.S. aircraft industry.

The X-15 is a mid-wing monoplane of small span, powered by a single-chamber Reaction Motors rocket engine which is rated at 60,000 lb. (27,200 kg.) s.t. at sea level and about 70,000 lb. (31,750 kg.) s.t. at peak altitudes.

Until this engine is ready, flight tests will be made with two Reaction Motors XLR-11 rocket motors installed in place of the single large motor.

The wings are of extremely-thin section, with a square trailing-edge that is reported to be 0.375 in. (9.525 mm.) deep at the tips and 2.125 in. (54 mm.) deep at the roots. Inset ailerons are fitted and the tailplane is of the one-piece "all-moving" type.

The dorsal and ventral fins have a wedge section with a square trailing-edge no less than 12 in. (0.30 m.) wide. Each contains small split air-brakes. The upper fin is pivoted for directional control; the lower fin is jettisoned before landing.

Almost all of the fuselage between the cockpit and the rocket motor comprises integral tankage for the fuels, which are reported to be liquid oxygen and anhydrous ammonia. This has necessitated carrying the controls and pipe-lines externally in large wedge-shape fairings which also reduce airflow interference between the wings and fuselage.

Control during the high-altitude phases of testing, above the effective atmosphere, will be achieved by means of jet nozzles, of the H.T.P. rocket type, in the wings and nose.

The first X-15 is scheduled to fly early in 1959. It will be air-launched from a B-52 Stratofortress, the pilot, chosen for its initial tests being North American test pilot Scott Crossfield. Later a U.S.A.F. service test pilot will establish its maximum speed and altitude capabilities, to obtain data and experience required in the design of future military projects, before the X-15 is handed over to the N.A.C.A. for detailed flight research.

An attempt will probably be made to establish one of the X-15's in a satellite orbit, by firing it vertically on the first part of its journey with the aid of a large booster rocket.

DIMENSIONS.—
Span 22 ft. (6.70 m.).
Length 50 ft. (15.25 m.).
Height across fin tips 13 ft. 6 in. (4.10 m.).

WEIGHT.—
Weight loaded 31,276 lb. (14,185 kg.).

THE NORTH AMERICAN SABRELINER.

To meet the U.S.A.F.'s "UTX" requirements for a combat readiness trainer and utility aircraft, North American has built as a private venture the prototype of a small swept-wing twin-jet monoplane named the Sabreliner. Design work was started early in 1956, and the prototype flew for the first time on September 16, 1958. Commercial and executive transport versions may also be offered.

TYPE.—Twin-engined Utility Jet trainer.

WINGS.—Cantilever monoplane type. All-metal two-spar structure. Sweep-back 28.5°. Trim-tab in each aileron. Trailing-edge flaps. Leading-edge slats. Thermal anti-icing of leading-edges. Wing area 344 sq. ft. (32.0 m.²).

FUSELAGE. — All - metal semi - monocoque structure. Large hydraulically - operated air-brake under centre-fuselage.

TAIL UNIT.—Cantilever monoplane type with moderate sweepback on all surfaces. "All-flying" horizontal surfaces. Trim tab in rudder. All-metal structure, with flush antennae forming tip of fin and inset in dorsal fin. Thermal anti-icing of leading-edges. Tailplane span 17 ft. 6½ in. (5.35 m.).

LANDING GEAR.—Retractable tricycle type. Single wheels on main units, twin wheels on nose unit. Hydraulic brakes.

POWER PLANT.—Two General Electric J85 turbojet engines in pods on sides of rear fuselage. Integral fuel tanks in wings.

ACCOMMODATION.—Crew of two and 4-8 passengers in pressurised air-conditioned cabin. Pressurisation maintains cabin altitude of 8,000 ft. (2,440 m.) at 45,000 ft. (13,700 m.). Downward-hingeing entrance door with built-in steps forward of wing on port side. Emergency exits on starboard side of cabin and in floor aft of air-brake which acts as windshield. Baggage space at front of cabin opposite door in all versions, with adjacent coat rack in 4/5-passenger versions. With seats removed can accommodate 2,500 lb. (1,135 kg.) of freight.

DIMENSIONS.—
Span 42 ft. 5 in. (12.93 m.).
Length 43 ft. 9 in. (13.33 m.).
Height 16 ft. 5 in. (5.01 m.).

WEIGHTS.—
Weight empty 8,153 lb. (3,700 kg.).
Weight loaded 15,330 lb. (6,954 kg.).

PERFORMANCE (estimated).—
Max. speed 575 m.p.h. (925 km.h.).
Single-engine ceiling 23,000 ft. (7,000 m.).
Range with six persons, with reserves, 1,380 miles (2,225 km.).

THE NORTH AMERICAN VIGILANTE.

U.S. Navy designation: A3J.

After a U.S. Navy design competition in 1956, North American Aviation received a contract to build a small batch of prototypes of the A3J in September of that year. Subsequent design and development of the aircraft has been entrusted to the company's Columbus Division.

The A3J, named the Vigilante in May, 1958 when the first prototype was completed, is a twin-jet two-seat carrier-based all-weather attack bomber. Intended for high-altitude operation, its specification called for the ability to carry thermonuclear weapons over a range of several hundred miles at an over-target speed of better than Mach 2.

A unique feature of the A3J is that its bombs are ejected out of the tail from a "linear" bomb-bay, consisting of a tunnel inside the rear fuselage. It can carry a variety of air-to-surface guided missiles and can be equipped with a "buddy tanker" refuelling pack.

The first A3J flew for the first time on August 31, 1958.

TYPE.—Carrier-based Attack bomber.

WINGS.—Cantilever high-wing monoplane. Thickness/chord ratio approximately 3.5%. All-metal structure. Variable-camber leading-edge. Spoilers in place of ailerons. Flap-blowing system. Wings fold for carrier stowage. Flaps operated pneumatically (by nitrogen gas system).

FUSELAGE. — All-metal semi-monocoque structure, widened aft of cockpit to accommodate engines. Very large pneumatically-operated (by nitrogen gas) air-brake extending across full width of fuselage-nacelle structure under centre-fuselage.

TAIL UNIT.—Cantilever monoplane type. One-piece tailplane. Fin folds for carrier stowage.

LANDING GEAR.—Retractable tricycle type, all units retracting into fuselage. Hydraulic retraction. All units fitted with single wheel. Main wheels size 36×11, with hydraulic multiple-disc brakes. Nose-wheel size 26×6.6. Steerable nose-wheel.

POWER PLANT.—Prototypes have two General Electric J79-GE-2 turbojets with afterburners, each rated at 10,500 lb. (4,763 kg.) s.t. dry or 15,000 lb. (6,805 kg.) s.t. with afterburning. Later aircraft will have two General Electric J79-GE-4 turbojets.

ACCOMMODATION.—Crew of two in tandem under separate large rearward-hingeing canopies. Advanced-type ejection seats with integral folding fins to stabilise them after ejection.

ARMAMENT.—Variety of weapons, including thermonuclear bombs, can be accommodated in very large internal weapons-bay.

DIMENSIONS (approx.).—
Span 50 ft. (15.25 m.).
Length 70 ft. (21.34 m.).
Height 20 ft. (6.10 m.).

WEIGHT.—
Weight loaded approx. 49,500 lb. (22,450 kg.).

PERFORMANCE.—
No details available.

THE NORTH AMERICAN B-70 VALKYRIE.

After an intensive two-year design competition, it was announced in December, 1957 that North American had been awarded a contract to develop a supersonic intercontinental bomber, then known by the weapon system designation of WS-110A. Subsequently designated the B-70, this aircraft is intended as a replacement for the B-52 Stratofortress.

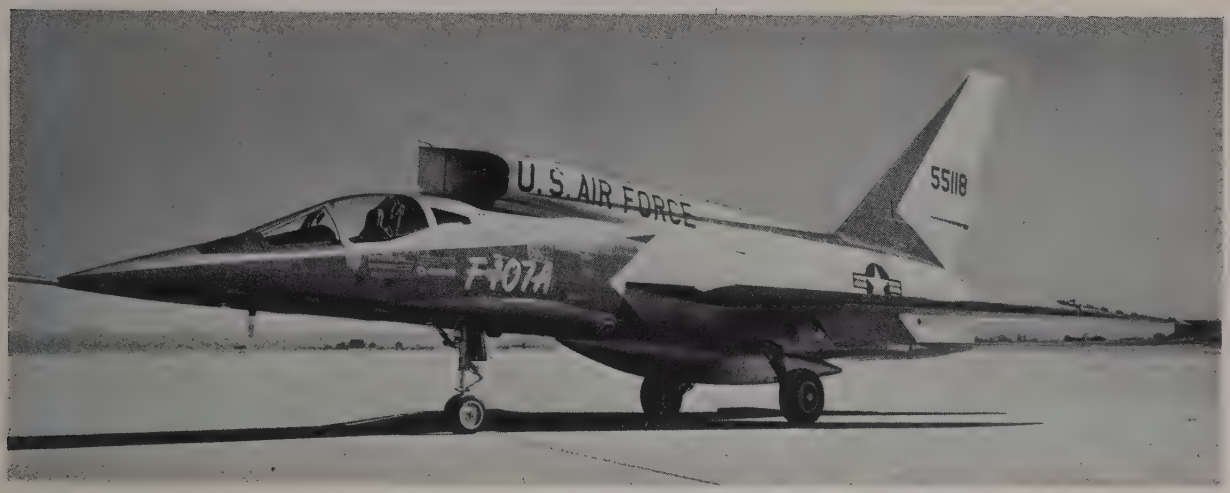
Few details of the B-70 have been released officially, except that it will be capable of speeds in excess of 2,000 m.p.h. (3,220 km.h.) at altitudes above 70,000 ft. (21,350 m.); but it is reported to have six General Electric J93 turbojets, each rated at 30,000 lb. (13,600 kg.) s.t. with afterburners in continuous use.

THE NORTH AMERICAN F-108.

Known originally by the weapon system designation of WS-202A, the F-108 is a long-range interceptor which North American is developing for the U.S.A.F. It has been stated to be virtually independent of ground support and to "have the speed and range to fill any gap in America's complex surface-to-air missile and electronic defensive network." No details are available, except that the F-108 will be powered by two



The North American A3J-1 Vigilante Attack Bomber (two General Electric J79 turbojet engines and afterburners).



The North American F-107A (Pratt & Whitney J75 turbojet engine and afterburner).



The North American F-107A (Pratt & Whitney J75 turbojet engine and afterburner).

General Electric J93 turbojets and will be in the Mach 3 class.

THE NORTH AMERICAN F-107A.

The F-107A, originally designated F-100B, was to have been an advanced fighter-bomber development of the F-100 Super Sabre. It is powered by a Pratt & Whitney J75 engine with afterburner, the bifurcated air intakes for which are on top of the fuselage behind the cockpit.

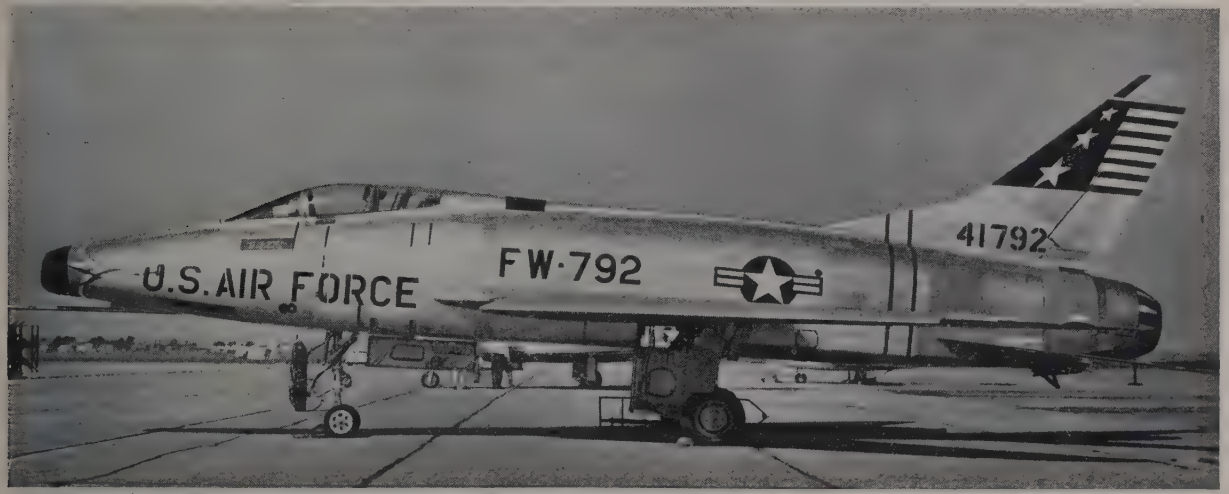
These intakes have a central knife-edge, which creates inclined shock-waves to slow airflow entering the engine at supersonic speeds. The flying control system is also unique, with a one-piece "all-moving" fin and spoiler-type ailerons.

Three F-107A's were built. The first made its maiden flight on September 10, 1956 and exceeded Mach 2.0 on many occasions during subsequent test flights at Edwards A.F.B., California. Further development was cancelled as an economy move in 1957, but two of the aircraft have been turned over to the N.A.C.A. for high-speed flight research. The third is in the Air Force Museum at Wright-Patterson A.F.B., Dayton, Ohio.

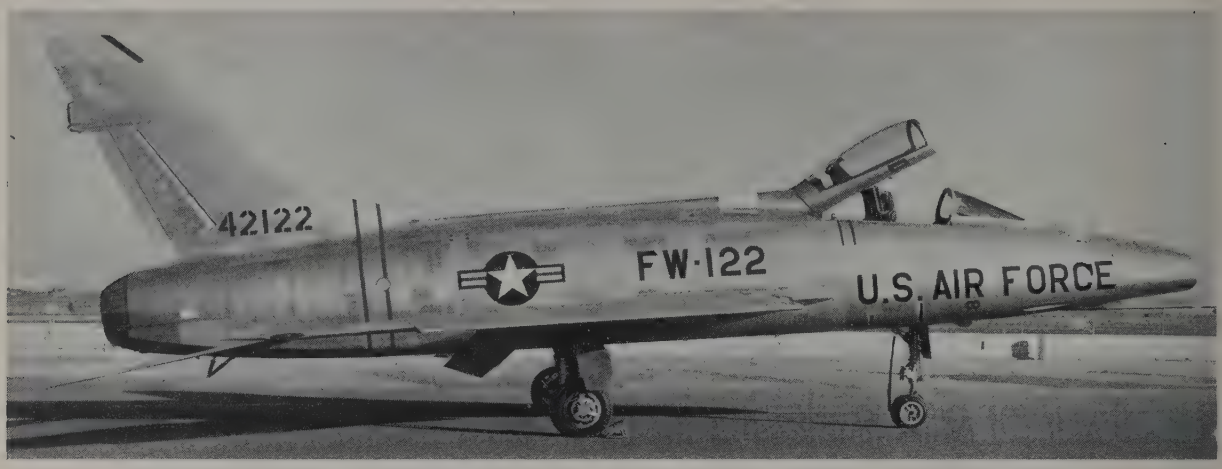
DIMENSIONS.—
Span 36 ft. 7 in. (11.15 m.).
Length 60 ft. 10 in. (18.54 m.).
Height 19 ft. 8 in. (6.0 m.).

THE NORTH AMERICAN SUPER SABRE.
U.S. Air Force designation: F-100.

The F-100 was the first supersonic operational fighter to be developed for the U.S.A.F. The prototype YF-100A, powered by a Pratt & Whitney J57-P-7 turbojet engine fitted with an afterburner, flew for the first time on May 25, 1953. It exceeded the speed of sound in level flight on its first 35-minute flight.



The North American F-100C Super Sabre (Pratt & Whitney J57 turbojet engine and afterburner). *(Gordon Williams).*



The North American F-100D Super Sabre (Pratt & Whitney J57 turbojet engine and afterburner).

On August 20, 1955, Colonel H. A. Hanes, U.S.A.F., flying an F-100C Super Sabre established the first supersonic speed record of 822.125 m.p.h. (1,323 km.h.).

Five versions of the F-100 have been announced, as follows :—

F-100A. Initial production version. Day fighter with Pratt & Whitney J57-P-7 or J57-P-39 turbojet, with afterburner. In production at North American's Los Angeles plant from mid-1953. Production completed in 1955.

F-100B. Fighter-bomber development. Design was revised sufficiently to justify re-designation as F-107A (which see).

F-100C. Fighter-bomber with Pratt & Whitney J57-P-21 engine. Fitted with in-flight refuelling for internal tanks only and provision for carrying extra drop fuel tanks and bombs under the wings. Improved electronic bombing equipment. Standard armament of four 20 mm. cannon. First F-100C from Los Angeles Division flew on January 17, 1955. Production also undertaken by Columbus Division and first Columbus-built F-100C flown in September, 1955.

F-100D. Fighter-bomber. Similar to F-100C with improvements that include the fitting of flight refuelling probe for replenishing both internal and external tanks, wing flaps on centre-section trailing-edge, tail-warning radar and a Minneapolis Honeywell autopilot. This latter is able to control the aircraft at supersonic speed, leaving the pilot free to concentrate on navigation and tactics. Bomb-load raised to 7,500 lb. (3,400 kg.). First flight of F-100D on January 24, 1956.

Following a series of experimental zero-length launching trials, using a 130,000 lb. (59,000 kg.) s.t. Astrodyne rocket to supplement the J57 turbojet, all production F-100D's are now being built with fittings for this type of operation.

F-100F. Two-seat version able to be used as fighter-bomber, air-superiority fighter or trainer. Fixed armament reduced from four to two M-39 cannon. Ordered into production in 1956. Prototype (designated TF-100C) flew on August 12, 1956 and the first production F-100F on March 8, 1957. Length increased by 3 ft. (0.91 m.).

A "buddy" system of flight refuelling has been developed for the F-100 by Flight Refueling Inc. of Baltimore, Maryland. Under this system, one F-100 is able to take fuel from another which trails a hose and drogue from a standard-size streamlined external pod carried under its wing. Upon completion of the operation, the entire equipment retracts automatically into the pod, so that performance is not penalised. In addition to the fuel available within the refuelling pod, the F-100 "tanker" is able to dispense fuel from its external tanks.

Another new item of equipment, designed to be fitted to the F-100D but suitable for use on other versions of the Super Sabre, is the North American Center Line Tow Target Boom. With this in place under the fuselage, the pilot can snatch a target off the ground, to provide air-to-air firing practice for other fighters, at supersonic speeds.

The F-100D and F-100F are able to carry either atomic or thermonuclear bombs, in addition to conventional weapons.

The following brief description refers specifically to the F-100C.

Type. — Single-seat supersonic Fighter-bomber.

Wings.—Low-wing cantilever monoplane with 7% thickness-chord ratio. 45° sweepback, aluminium alloy spars, ribs and tapered skin. Inset ailerons each split into two sections. Automatic leading-edge slats. No flaps.

Fuselage.—All-metal structure. Rectangular air brake hinged beneath fuselage approximately in line with front wing spar.

Tail Unit.—Monoplane type. All surfaces have 45° sweepback. One-piece "all-flying" horizontal stabiliser. Braking parachute housed in bottom of fuselage. Span of tail 18 ft. (5.5 m.).

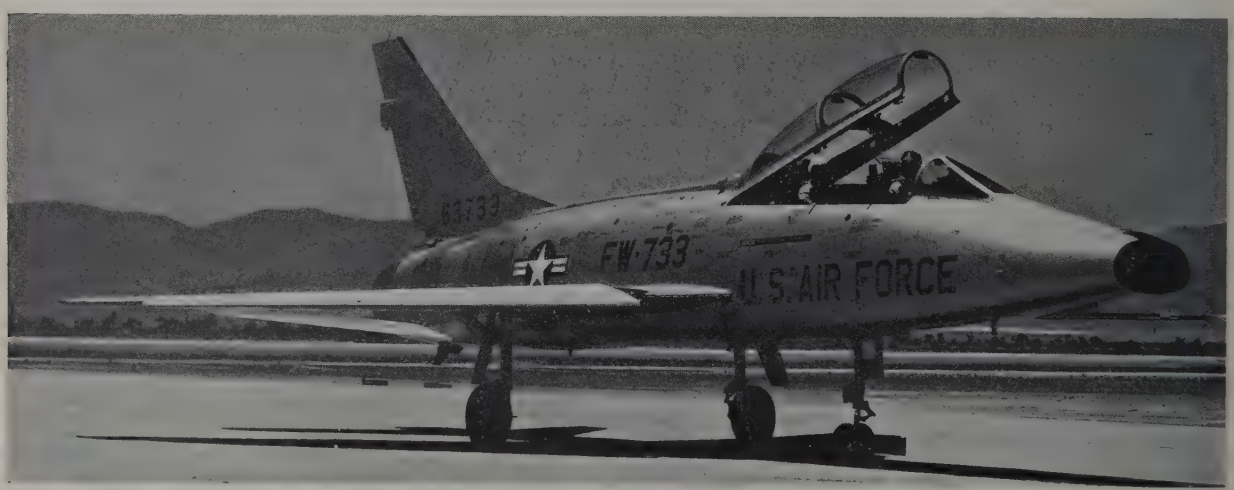
Landing Gear.—Retractable tricycle type, with steerable twin nose-wheels. Hytrol anti-skid sensing units on segmented-rotor brakes. Track of main wheels 12 ft. (3.6 m.).

Power Plant.—One Pratt & Whitney J57-P-21 turbojet engine with afterburner. Automatic fuel system. Total internal fuel capacity 1,195 U.S. gallons (4,523 litres) in wing, fuselage and annular engine-bay tanks, filled from single point on port rear fuselage. Two under-wing 275 U.S. gallon (1,041 litre) tanks may be carried. Provision for flight refuelling internal tanks only. Probe on starboard wing inboard of underwing tank shackles.

Accommodation.—Pilot's cockpit forward of wings with one-piece clamshell-type jettisonable canopy. Automatically-regulated air conditioning and pressurising system. Ejection seat.

Armament.—Four 20 mm. M-39E cannon with 200 rounds per gun. Six under-wing pylons for up to 6,000 lb. (2,720 kg.) of H.E. or Napalm bombs, 24×5 in. rockets, Sidewinder air-to-air missiles, pods of 2.75 in. air-to-air rockets, etc. Type A-4 radar gunsight.

Dimensions.—
Span 38 ft. (11.58 m.).
Length 47 ft. (14.33 m.).
Height 16 ft. (4.88 m.).



The North American F-100F Super Sabre (Pratt & Whitney J57 turbojet engine and afterburner).



The North American F-86D Sabre Single-seat All-weather Fighter (General Electric J47 turbojet engine).
(J. W. R. Taylor).

WEIGHT.—
Weight loaded approx. 28,000 lb. (12,700 kg.).
PERFORMANCE.—
Max. speed with afterburner 822 m.p.h. (1,323 km.h.) at 35,000 ft. (10,670 m.).
Stalling speed approx. 150 m.p.h. (241 km.h.).
Landing speed approx. 179 m.p.h. (287 km.h.).
Service ceiling over 50,000 ft. (15,250 m.).
Combat radius 575 miles (920 km.).
Take-off run with afterburning approx. 4,500 ft. (1,370 m.).

THE NORTH AMERICAN SABRE.
U.S. Air Force designation: F-86.

Production of the Sabre by North American came to an end in December, 1956, after nine years. Versions have also been built under licence in Canada by Canadair, Ltd. and in Australia by the Commonwealth Aircraft Corporation Pty. Ltd. The Canadian production Sabre has been supplied in quantity to the R.C.A.F., U.S.A.F., R.A.F. and the air forces of several other nations. The Australian-built Sabre is fitted with the Rolls-Royce Avon engine.

Under an agreement signed late in 1955, North American is supplying parts for the assembly in Japan by the Mitsubishi company of F-86F Sabres for the Japanese Air Self-Defence Force.

The F-86K was ordered by the U.S.A.F. under the Mutual Defense Assistance Programme for production in Italy by Fiat for N.A.T.O. countries.

The following are the principal current versions of the F-86 :—

F-86D. General Electric J47-GE-17 (5,200 lb.=2,360 kg. s.t.) in earlier production aircraft, and J47-GE-33 (7,650 lb.=3,470 kg. s.t.) in later aircraft, both engines with afterburners. All-weather interceptor. Air intake re-positioned under nose, which now encloses radar scanner. Larger rear fuselage to accommodate afterburner. All-flying tail. Armament consists of 24 × 2.75 in. rockets which are carried in a retractable launching tray located in the underside of the fuselage. Overall length 41 ft. (12.5 m.). Other dimensions as for F-86E. Prototype flew on December 22, 1949, and first production F-86D in March, 1951. The last was delivered in September, 1955.

F-86F. One General Electric J47-GE-27 engine. First production F-86F flew on March 19, 1952. Being built under licence in Japan by Mitsubishi.

F-86H. General Electric J73-GE-3 engine (9,300 lb.=4,218 kg. s.t.). Fuselage 6 in. (15.2 cm.) deeper. First armed with six 0.50-in. guns but later with four 20 mm. M-39 cannon. Higher powered fighter-bomber version of F-86F, with larger tailplane without dihedral, electrically-operated flaps, hydraulically-operated speed brakes and controls, heavier landing-gear, improved suspension and release mechanism for carrying droppable wing tanks in conjunction with bombs and rockets. Clamshell-type canopy as in F-86D, improved ejector seat, etc. Two prototypes built at Los Angeles, the first making its maiden flight on April 30, 1953. First production F-86H flew on September 4, 1953 and the type remained in production at Columbus until August, 1955. Span : 37 ft. 1 in. (11.3 m.). Length : 38 ft. 9 in. (11.8 m.). Height : 15 ft. (4.57 m.).

F-86K. General Electric J47-GE-33 engine (5,600 lb.=2,540 kg. s.t.) with afterburner. Ordered by U.S.A.F. with M.D.A.P. funds for delivery to N.A.T.O. countries. Similar to F-86D but fitted with four 20 mm. cannon instead of rocket armament and Type MG-4 fire control system. Fuselage is 8 in. (20.3 cm.) longer than that of F-86D. Was built under licence by Fiat in Italy. First U.S.-built YF-86K flew on July 5, 1954, and first production F-86K from Los Angeles plant in March, 1955.

F-86L. This designation has been given to F-86D aircraft after modification to new standards at Los Angeles Modification Center and Fresno plant. The F-86L accommodates "Data Link" equipment which receives intercept information and directions from the SAGE (Semi-Automatic Ground Environment) electronic air defence monitoring computer, and links data with pilot's instruments. F-86L's, in service with U.S.A.F. Air Defense Command, are being used to evaluate flying phase of SAGE which, when it becomes fully operational, will form, in conjunction with network of radar "picket" ships, early-warning radar aircraft and land-based radar stations, a solid interlocking radar ring around the United States through and over which it will be impossible to fly undetected. Other changes on the F-86L include a new slotted wing leading edge and new wing-tips that increase span by 2 ft. (0.60 m.). Deliveries began late in 1956. Contracts involve modification of over 800 F-86D interceptors to F-86L standard.

The description which follows refers to the F-86F.



The North American F-86K Single-seat All-weather Interceptor Fighter as built by Fiat in Italy.



The North American F-86L Sabre (General Electric J47 turbojet engine).

TYPE.—Single-seat Fighter.

WINGS.—Low-wing cantilever monoplane. Modified NACA 0012-64 (root), 0011-64 (tip) wing section. Maximum thickness at 50% of chord. 35° sweepback along 25% chord line. All-metal two-spar structure with upper and lower skins each of which is a sandwich consisting of two sheets milled to tapering thickness separated by "hat" section extrusions, the whole forming a torsion-box structure. Aileron hydraulic boost and artificial fuel system. Split flaps inboard of ailerons. Wing area 287.9 sq. ft. (26.75 m.²).

FUSELAGE.—Oval section all-metal structure with flush-riveted stressed skin. Air brakes on fuselage.

TAIL UNIT.—Cantilever monoplane type. All-metal structure. All surfaces have 35° sweep-back. "Flying tail" in which elevators and tailplane are geared together and move differentially with movements of control column to provide in-flight trim.

LANDING GEAR.—Retractable tricycle type with steerable nose-wheel. Hydraulic retraction. Cleveland 8657 air-oil shock struts. Bendix 26 in. (66 cm.) cast magnesium wheels and Bendix rotor-disc hydraulic brakes on main wheels. Track 8 ft. 3 in. (2.5 m.).

POWER PLANT.—One General Electric J47-GE-27 turbojet (5,970 lb.=2,708 kg. s.t.). Nose entry lipped above to maintain adequate air flow in nose-up position. Main fuel tanks in fuselage. External long-range drop-tanks may be carried under wings outboard of landing gear.

ACCOMMODATION.—Pressurised pilot's cockpit with sliding "bubble" canopy. Pilot ejection seat.

ARMAMENT.—Six 0.50-in. (12.7 mm.) machine-guns in nose. Provision for sixteen 5-in. (127 mm.) rockets under wings. May also carry 2 × 1,000-lb. bombs in lieu of auxiliary tanks.

DIMENSIONS.—
Span 37 ft. 1 in. (11.3 m.).
Length 37 ft. 6 in. (11.45 m.).
Height 14 ft. (4.27 m.).

WEIGHTS.—
Weight empty 10,950 lb. (4,967 kg.).
Weight loaded 16,860 kg. (7,647 lb.).

PERFORMANCE.—
Max. speed over 670 m.p.h. (1,072 km.h.).
Service ceiling: 53,000 ft. (16,170 m.).
Normal cruise range: 1,250 miles (2,000 km.).

THE NORTH AMERICAN FURY.

U.S. Navy designation: FJ.

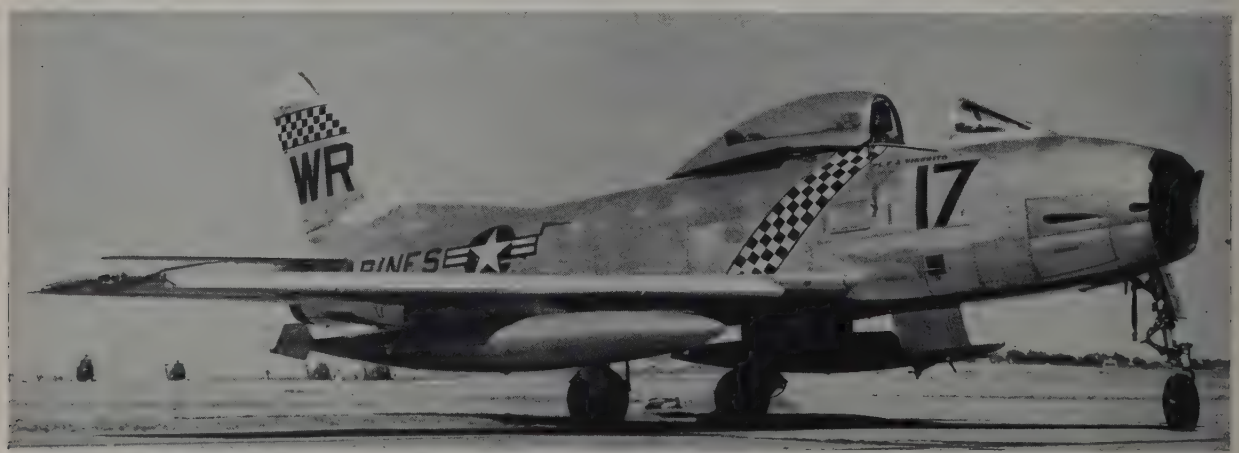
The latest versions of the Fury are single-seat swept-wing carrier fighters developed from the F-86 Sabre.

The landing-gear is similar to that of the Sabre but the nose-wheel unit is so designed that the normal nose-up static attitude can be increased for catapulting. Extension of the nose-wheel shock strut is by hydraulic means and is achieved by a manually-controlled selector valve which is operated by the carrier deck crew. When the landing-gear is retracted after take-off hydraulic fluid returns to the reservoir. The extendable nose-wheel strut increases the angle between the thrust line and deck from 4 to 8 degrees.

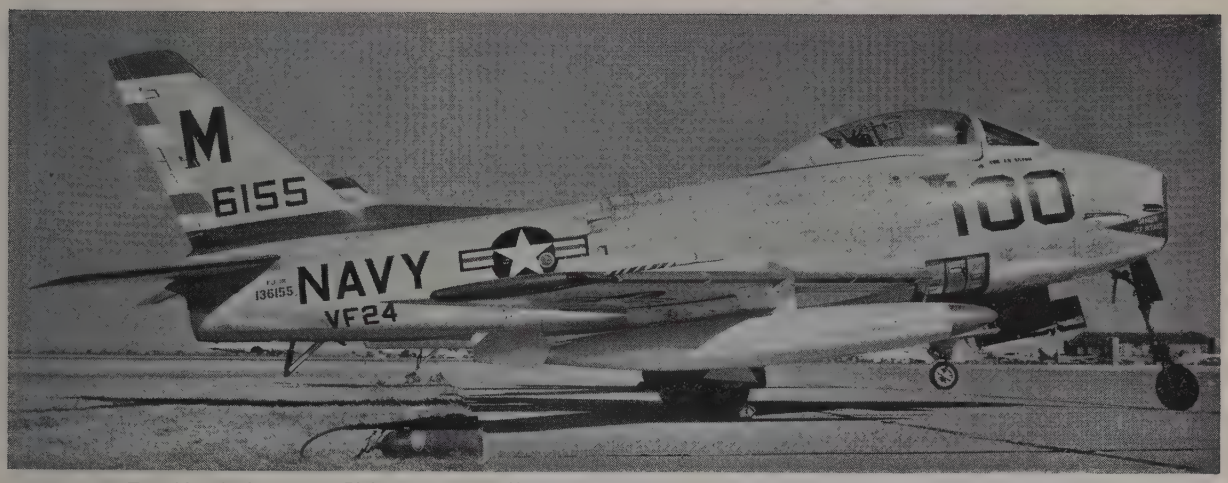
Armamont consists of four 20 mm. cannon and, on the later versions, six Philco Sidewinder air-to-air missiles. A Navy gun-sight and an improved Navy ejection-seat are fitted.

The following versions of the swept-wing Fury have been announced:—

FJ-2. General Electric J47-GE-2 engine (5,270 lb.=2,390 kg. s.t.). First production version. The prototype XFJ-2, which first flew on February 14, 1952, was a semi-navalised F-86E without



The North American FJ-2 Fury Naval Fighter (General Electric J47 turbojet engine). (*Gordon Williams*).



The North American FJ-3M Fury Naval Fighter (Wright J65 turbojet engine). (*Gordon Williams*).

folding wings or armament. The cannon armament was first installed in the XFJ-2B, which was otherwise a standard F-86E. Produced at Columbus, Ohio, and now in service with U.S. Navy Reserve units.

FJ-3. Wright J65-W-2 engine (7,200 lb.=3,270 kg. s.t.). Larger and slightly heavier version of FJ-2 with enhanced performance. Manufactured at Columbus, Ohio, and in service with U.S. Navy. XFJ-3 prototype flew for first time on July 3, 1953.

FJ-4. Wright J65-W-4 engine (7,800 lb.=3,540 kg. s.t.). Improved version of FJ-3. First aircraft designed, developed and built by Columbus Division of N.A.A. New thin wing with mechanically-drooped leading-edge, slotted flaps and drooping split ailerons, new thinner-section all-moving tail, redesigned long-stroke landing gear, addition of dorsal spine from fin to cockpit. Can be equipped with "buddy" system of flight refuelling as described under entry for North American Super Sabre. First of two prototype FJ-4's flew on October 28, 1954, and first production model in March, 1955.

FJ-4B. Attack fighter with Wright J65-W-16A engine (approximately 7,800 lb.=3,540 kg. s.t.). Basically similar to FJ-4, with low altitude bombing system and control system improvements for high speeds at very low altitude. Armament comprises four 20 mm. cannon, and six Sidewinder air-to-air missiles, or six bombs, or rockets, or four external tanks with total capacity of 700 U.S. gallons (2,650 litres). First FJ-4B flown on December 3, 1956.

FJ-4F. Under this designation, two FJ-4 aircraft have been flight tested with a North American Rocketdyne AR-1 rocket engine built into their fuselage, above the turbojet tailpipe. Significant improvements in speed and altitude performance have been achieved, using as propellants the aircraft's normal turbine fuel and hydrogen peroxide. Test instrumentation is carried in a fairing at the top of the nose air intake.

DIMENSIONS (FJ-3).—
Span 37 ft. 1 in. (11.3 m.).
Length 37 ft. 6 in. (11.45 m.).
Height 13 ft. 8 in. (4.16 m.).
DIMENSIONS (FJ-4 and FJ-4B).—
Span 39 ft. 1 in. (11.92 m.).
Length 37 ft. 6 in. (11.45 m.).
Height 12 ft. 8 in. (3.86 m.).
Width folded 27 ft. 6 in. (8.38 m.).
WEIGHTS.—
Max. T.O. weight (FJ-3) over 18,000 lb. (8,170 kg.).
Max. T.O. weight (FJ-4) over 19,000 lb. (8,626 kg.).
Max. T.O. weight (FJ-4B) over 26,000 lb. (11,795 kg.).
PERFORMANCE (FJ-3).—
Max. speed 650 m.p.h. (1,050 km.h.).
Service ceiling 45,000 ft. (13,700 m.).
Combat range over 1,030 miles (1,650 km.).
PERFORMANCE (FJ-4).—
Max. speed over 690 m.p.h. (1,110 km.h.).
Service ceiling over 45,000 ft. (13,700 m.).

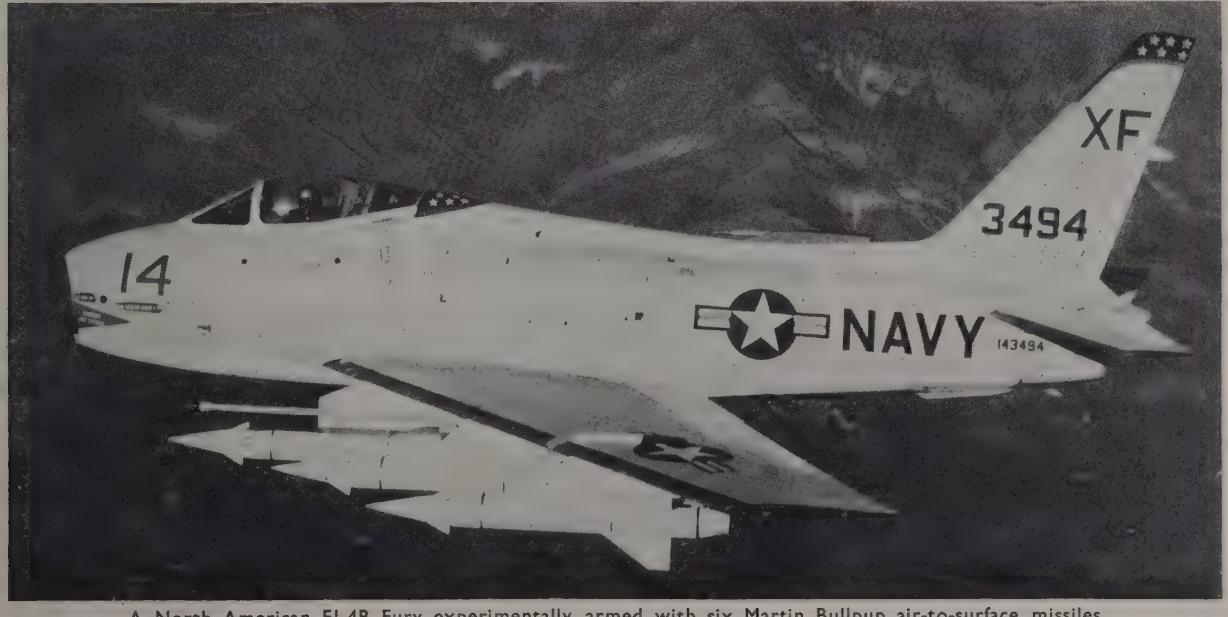
THE NORTH AMERICAN NAA-249.
U.S. Navy Designation: T2J-1.

After a design competition among several leading U.S. manufacturers, North American was awarded a contract in 1956 to develop a new jet training aircraft for the U.S. Navy. Designated T2J-1, this aircraft is being built in the company's Columbus Division.

Designed for use throughout the complete syllabus of pilot training, from *ab initio* instruction to carrier indoctrination, the T2J-1 is in production in substantial quantity for the U.S. Navy. There was no prototype, and the first production T2J-1 flew on January 31, 1958.

The standard T2J-1 is a tandem two-seater with a Westinghouse J34-WE-36 turbojet; but North American are offering an alternative version with a Bristol Orpheus turbojet. Emphasis is placed on the use of proven airframe components and power-plant, with off-the-shelf equipment. Thus the wing is basically similar to that of North American's original FJ-1 Fury jet fighter and the basic control system is that of the T-28C trainer, with an added hydraulic powered system.

TYPE.—Two-seat General-purpose Jet Trainer.
WINGS.—Mid-wing cantilever monoplane. Wing section NACA 64A212 (modified). Thickness/chord ratio 12%. All-metal two-spar structure. Interchangeable all-metal ailerons, with hydraulic boost. Large all-metal trailing-edge flaps. Total area of



A North American FJ-4B Fury experimentally armed with six Martin Bullpup air-to-surface missiles.



The North American T2J-1 Naval Trainer (Westinghouse J34 turbojet engine).

flaps 50 sq. ft. (4.65 m.²). Gross wing area 255 sq. ft. (23.69 m.²).

FUSELAGE.—All-metal semi-monocoque structure in three main sections: forward fuselage containing equipment bay and cockpit; centre fuselage housing power plant, fuel and wing carry-through structure: and rear fuselage, the undersurface of which has stainless steel skin in way of jet exhaust. Hydraulically-actuated air brake on each side of rear fuselage.

TAIL UNIT.—Cantilever monoplane type. All-metal structure. Each half of tailplane and elevators interchangeable. Elevators boosted hydraulically. Rudder manually controlled. Trim-tabs in elevators and rudder. Areas: fin 27.29 sq. ft. (2.54 m.²), rudder 10.71 sq. ft. (0.99 m.²), tailplane 50.34 sq. ft. (4.68 m.²), elevators 17.66 sq. ft. (1.64 m.²). Tailplane span 17 ft. 9 in. (5.40 m.).

LANDING GEAR.—Retractable tricycle type. Oleo-pneumatic shock-absorbers. Hydraulic retraction. Main units retract inward into wings. Nose-wheel retracts forward into fuselage. Main wheels 24 × 5.5. Nose-wheel 20 × 4.4. Single-disc hydraulic brakes. Retractable sting-type arrester hook. Wheel track 18 ft. 5 in. (5.62 m.).

POWER PLANT.—One Westinghouse J34-WE-36 turbojet engine (3,400 lb. = 1,540 kg. s.t.) with jet outlet under rear fuselage. Fuel in main tank over engine with capacity of 381 U.S. gallons (1,442 litres) and two wingtip tanks each of 100 U.S. gallons (379 litres). Total fuel capacity 581 U.S. gallons (2,200 litres).

ACCOMMODATION.—Pupil and instructor in tandem in enclosed cabin, on ejection seats. Instructor is raised 10 in. (0.25 m.) above level of pupil and has closed-circuit transistorized TV gunnery instruction monitor to check pupil's accuracy of aim.

ARMAMENT.—Optional packaged installations of guns, target-towing gear, 100 lb. practice bombs, M-5 practice bomb clusters, Type T-1 practice bomb containers, 2.25 in. rocket launchers or 2.75 in. Mighty Mouse rocket packs.

DIMENSIONS.—
Span 36 ft. 0 in. (10.97 m.).
Length 38 ft. 9 in. 11.80 m.).
Height 14 ft. 9 in. (4.50 m.).

WEIGHT.—
Weight loaded 9,480 lb. (4,300 kg.).

PERFORMANCE (estimated).—
Max. speed 495 m.p.h. (795 km.h.).
Stalling speed 75 m.p.h. (120 km.h.).
Rate of climb at S/L. 5,000 ft./min. (1,500 m./min.).
Service ceiling 41,000 ft. (12,500 m.).
Take-off distance to 50 ft. (15.25 m.) 2,010 ft. (613 m.).
Landing distance from 50 ft. (15.25 m.) 1,690 ft. (515 m.).
Range 964 miles (1,550 km.).

THE NORTH AMERICAN T-28.

The T-28 was originally designed for the U.S.A.F. as a replacement for the T-6 and it went into production for the U.S.A.F. in 1950 as the T-28A.

In 1952, following the policy of standardisation of training aircraft for all the services, the T-28 was adopted by the U.S. Navy and in modified form was put into production under the designation T-28B and, later, as the T-28C.

The three T-28 versions differ in the following respects:—

T-28A. 800 h.p. Wright R-1300-1 seven-cylinder radial engine and Aero Products two-blade constant-speed airscrew. U.S.A.F. advanced trainer. Out of production in 1953.

T-28B. 1,425 h.p. Wright R-1820 engine driving a three-blade Hamilton Standard constant-speed airscrew. U.S. Navy advanced trainer structurally similar to T-28A. New cockpit canopy, which was also introduced in later production T-28A's. Air brake on lower surface of fuselage. All training armament external with gun mounts, rocket and bomb racks under wings. Gunsight and camera in front cockpit. Rearrangement of radio, electrical and oxygen equipment.

T-28C. Same as T-28B but equipped with arrester hook, etc. for operation from aircraft-carriers. First T-28C flown on September 19, 1955.

Production of the T-28 ended in the Autumn of 1957, when a total of 1,948 of the three different versions had been built.

TYPE.—Two-seat Basic Trainer.

WINGS.—Low-wing cantilever monoplane. Two-spar all-metal structure. Trailing-edge flap between ailerons and fuselage. Total flap area 53.6 sq. ft. (4.98 m.²). Gross wing area 268 sq. ft. (24.89 m.²).

FUSELAGE.—All-metal semi-monocoque structure.

TAIL UNIT.—Cantilever monoplane type. All-metal structure. Area of fin and rudder 30.3 sq. ft. (2.81 m.²), area of tailplane and elevators 59.7 sq. ft. (5.54 m.²).

LANDING GEAR.—Retractable tricycle type. Main wheels with Goodyear single-disc brakes retract inwardly into wings, nose-wheel backwards into fuselage. United Aircraft Products air-oil shock struts. Nose-wheel is steerable from either cockpit by electro-hydraulic boost control. Nose-wheel also carries a movable taxi light. Main wheel track 12 ft. 8 in. (3.86 m.).

POWER PLANT (T-28A).— One Wright R-1300-1 seven-cylinder radial air-cooled engine with a military and take-off rating of 800 h.p. and a normal rating of 700 h.p. Aero Products two-blade constant-speed airscrew 10 ft. (3.05 m.) diameter. Fuel capacity 125 U.S. gallons (473 litres).

POWER PLANT (T-28B).—One 1,425 h.p. Wright R-1820 engine driving a three-blade Hamilton Standard constant-speed airscrew, diameter 9 ft. 4 in. (2.84 m.).

ACCOMMODATION.—Tandem cockpits beneath single bubble canopy. Duplicated flight controls and instruments. Amber screen blind and night flying equipment with ultra-violet and infra-red instrument lighting.

ARMAMENT.—Provision for carrying bombs, 2.25 in. SCA rockets and .50 in. machine-guns.

DIMENSIONS (T-28C).—
Span 40 ft. 7 in. (12.37 m.).
Length 34 ft. 4 in. (10.45 m.).
Height overall 12 ft. 7 in. (3.84 m.).

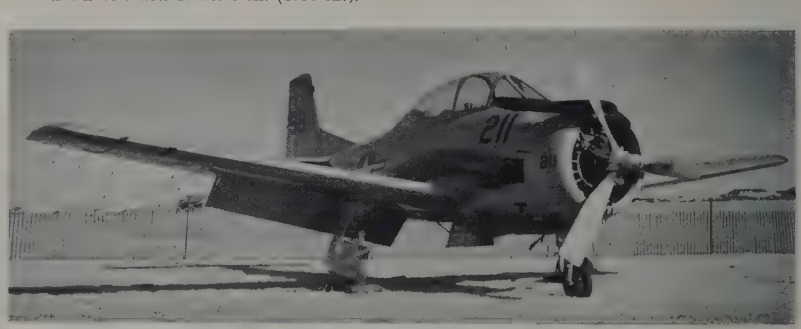
WEIGHTS AND LOADINGS (T-28A).—
Weight empty 5,111 lb. (2,320 kg.).
Normal loaded weight 6,365 lb. (2,890 kg.).
Max. take-off weight 6,759 lb. (3,068 kg.).
Wing loading 23.8 lb./sq. ft. (116.14 kg./m.²).
Power loading 7.96 lb./h.p. (3.61 kg./h.p.).

WEIGHTS AND LOADINGS (T-28B).—
Weight empty 6,424 lb. (2,916 kg.).
Normal loaded weight 8,004 lb. (3,634 kg.).
Max. T.O. weight 8,486 lb. (3,853 kg.).
Normal wing loading 29 lb./sq. ft. (141.52 kg./m.²).
Normal power loading 5.6 lb./h.p. (2.54 kg./h.p.).

WEIGHT (T-28C).—
Max. take-off weight 8,247 lb. (3,741 kg.).

PERFORMANCE (T-28A).—
Max. speed 285 m.p.h. (456 km.h.) at 5,900 ft. (1,800 m.).
Cruising speed 190 m.p.h. (304 km.h).
Stalling speed 72 m.p.h. (115.2 km.h.).
Initial rate of climb 2,030 ft./min. (628 m./min.).
Service ceiling 29,000 ft. (8,845 m.).
T.O. run to clear 50 ft. (15.25 m.) 570 yds. (521 m.).
Max. range 1,008 miles (1,612 km.).

PERFORMANCE (T-28B).—
Max. speed 346 m.p.h. (554 km.h.).
Cruising speed 310 m.p.h. (496 km.h.) at 30.000 ft. (9,150 m.).



The North American T-28C Naval Trainer. (*Gordon Williams*).

Initial rate of climb 3,830 ft./min. (1,168 m./min.).
Service ceiling 37,000 ft. (11,285 m.).
T.O. run to clear 50 ft. (15.25 m.) 380 yds. (348 m.).
Max. range 1,060 miles (1,696 km.) at 10,000 ft. (3,050 m.).

PERFORMANCE (T-28C).—
Max. speed approx. 346 m.p.h. (554 km.h.).
Service ceiling 35,000 ft. (10,670 m.).
Range over 860 miles (1,385 km.).

NORTHERN

NORTHERN AIRCRAFT, INC.

HEAD OFFICE AND WORKS: ALEXANDRIA, MINNESOTA.

President and General Manager: Roy L. Strong.

Northern Aircraft purchased from the former Bellanca Aircraft Corporation all tools, dies, jigs, fixtures, plans and patents for the full rights to manufacture and distribute the Cruisemaster 14-19 four-seat touring aircraft. They have begun production of a new version, with a more powerful engine, the prototype of which flew on July 25, 1956, followed by the first production aircraft on October 11, 1956.

Following a merger with American Aviation Corporation of Freeland, Michigan, Northern Aircraft are also responsible for the supply of components and modification kits for Republic Seabee amphibians in service throughout the world.



The Northern Cruisemaster (230 h.p. Continental O-470 engine).

THE CRUISEMASTER 14-19-2.

TYPE.—Four-seat cabin monoplane.

WINGS.—Cantilever low-wing monoplane. Aerofoil section Bellanca "B". Dihedral 4° 30'. Incidence 3° at tip. Wooden two-spar structure with stressed plywood covering and fabric overall. Wooden ailerons and plain-hinge trailing-edge flaps, with fabric covering. Total area of ailerons 11.77 sq. ft. (1.09 m.²). Total area of flaps 16.16 sq. ft. (1.50 m.²). Wing area 161.5 sq. ft. (15.0 m.²).

FUSELAGE.—Welded steel-tube structure with fabric covering.

TAIL UNIT.—Wire-braced monoplane type with additional stabilising fins at extremities of tailplane. Welded steel-tube framework with fabric covering for all surfaces except auxiliary fins which have wooden structure. Trim-tab in port elevator. Areas: fin 5.67 sq. ft. (0.53 m.²), rudder 6.28 sq. ft. (0.58 m.²), elevators 12.20 sq. ft. (1.13 m.²), tailplane 17.21 sq. ft. (1.60 m.²), auxiliary fins (2) total 4.4 sq. ft. (0.41 m.²). Tailplane span 12 ft. 1½ in. (3.73 m.).

LANDING GEAR.—Tail-wheel type, with retractable main wheels and fixed tail-wheel. Northern Aircraft oleo shock struts. Hydraulic retraction. Wheels protrude slightly below wing when retracted, to reduce damage in a wheel-up landing. Hydraulic shock-absorbers. Firestone wheels and tyres. Firestone brakes. Track 8 ft. 10⅝ in. (2.71 m.).

POWER PLANT.—One 230 h.p. Continental O-470-K six-cylinder horizontally-opposed air-cooled engine. Hartzell or McCauley two-blade metal constant-speed airscrew. One 20 U.S. gallon (75.5 litres) tank in each wing, with 14 U.S. gallon (53 litres) auxiliary tank behind rear seat. Oil capacity 3 U.S. gallons (11.4 litres).

ACCOMMODATION.—Enclosed cabin seating four in two pairs. Compartment for 186 lb. (85 kg.) baggage, with outside door.

DIMENSIONS.—
Span 34 ft. 2 in. (10.41 m.).
Length 22 ft. 10¾ in. (6.97 m.).
Height 6 ft. 2½ in. (1.89 m.).

WEIGHTS.—
Weight empty 1,640 lb. (744 kg.).
Weight loaded 2,700 lb. (1,225 kg.).

PERFORMANCE.—
Max. speed 206 m.p.h. (331 km.h.).
Cruising speed (75% power) 196 m.p.h. (315 km.h.).
Stalling speed 46 m.p.h. (74 km.h.).
Rate of climb at S/L 1,500 ft./min. (457 m./min.).
Service ceiling 20,000 ft. (6,100 m.).
Range 800 miles (1,285 km.).

NORTHROP

NORTHROP AIRCRAFT, INC.

HEAD OFFICE: BEVERLY HILLS, CALIFORNIA.

President: Whitley C. Collins.

Vice-President: Robert R. Miller.

Vice-President—Finance: Charles C. Cilley.

Vice-President—Corporate Development Planning: T. V. Jones.

Vice-President—Legal: William Larrabee.

Vice-President: J. Gilbert Nettleton, Jr.

Vice-President, Organization: P. W. Timberlake.

Vice-President: Dr. William F. Ballhaus.

Vice-President: M. W. Tuttle.

Secretary: George Gore.

Assistant Secretary (Washington, D.C.): S. W. Towle, Jr.

Assistant Secretary (Dayton, Ohio): L. H. Coates.

Assistant to the President: Irving Roth.

A major reorganisation of Northrop's corporate structure took place on February 28, 1957, when the Board of Directors approved the creation of an overall corporate organisation designed to free top executives for broad planning, policy formulation and direction, and the first moves towards the establishment of company operations under a line division structure.

Line divisions now established include the Northrop Division, specialising in aircraft and missiles; the Radioplane Division (formerly operated as a wholly-owned subsidiary), which is engaged primarily in the manufacture of target drones; Northrop International, which serves as the overseas marketing arm of the company; and Nortronics, created to handle Northrop activities in the design, development and manufacture of electronic, electro-mechanical and opto-mechanical products and components.

NORTHROP DIVISION.

DIVISION HEAD OFFICE: HAWTHORNE, CALIFORNIA.

Vice-President and General Manager: Robert R. Miller.

Vice-President, Manufacturing: Richard R. Nolan.

Vice-President, Customer Relations: John R. Alison.

Vice-President, Contracts: A. C. Morgan.

Vice-President, Engineering: George F. Douglas.

Treasurer: Dan H. Hill.

Assistant Treasurer: J. Grant Macdonnell.

Northrop Aircraft, Inc. was formed in 1939 by John K. Northrop and others to undertake the design and manufacture of military aircraft.

During World War II, the company built 1,131 aircraft of its own design and was engaged in extensive sub-contract work. It also devoted considerable attention to the design and construction of "Flying Wing" type aircraft. Details of this work together with descriptions and illustrations of the various "Flying Wing" types built have appeared in previous editions of "All the World's Aircraft."

Northrop's major post-war manned aircraft production programme has been centred on the F-89 Scorpion, which was the first U.S.A.F. aircraft designed from the start as an all-weather interceptor. Production of the Scorpion and modification work on the F-89J version, last of the series, has now ended, but the type remains in first-line service with various U.S.A.F. commands.

In May, 1956, Northrop was awarded a contract for the T-38 supersonic jet trainer, which it had been developing for two years with its own funds. The T-38 is now in initial production for the U.S.A.F., and the first aircraft was expected to fly in January, 1959. It will be the first U.S.A.F. jet basic trainer with performance characteristics similar to those of contemporary operational aircraft.

The T-38 is the first of a family of aircraft combining simple and lightweight structure with ease of maintenance, in order to achieve high performance at minimum cost. A second machine, of basically similar configuration, is the N-156F fighter, which has been designed to meet the specific requirements of NATO and SEATO countries.

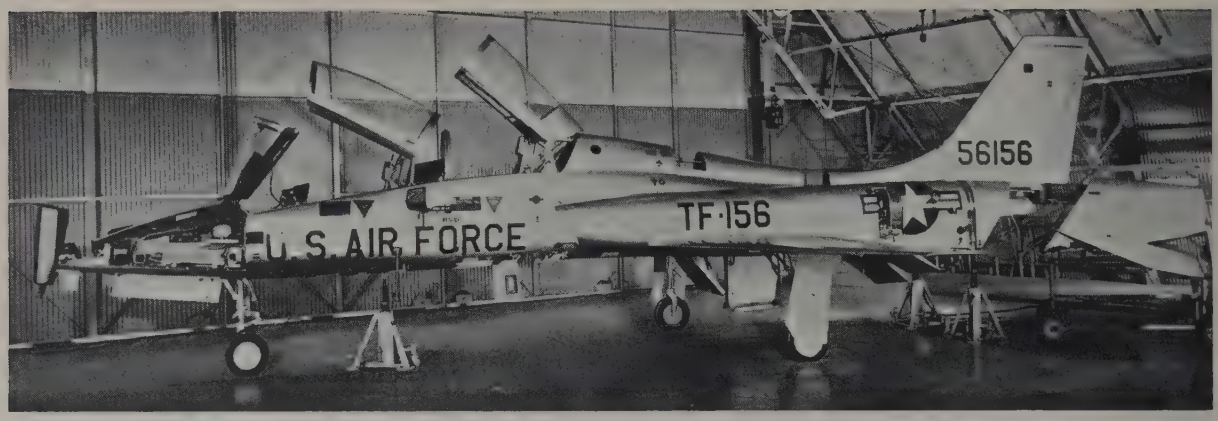
In addition to its work on manned military aircraft, Northrop has been engaged in the research, development and production of guided missiles since 1946. The first American intercontinental guided missile to be unveiled by the U.S. Air Force was the Northrop SM-62 Snark, which was ordered into series production after successful operational tests at the Missile Test Center in Florida, and which is now in service. Details and a photograph of the Snark will be found in the "Guided Missiles" Section. No details are available of the other types of guided missile under development by Northrop.

Late in 1957, Northrop completed the construction of extensive new facilities at the Northrop Division plants in Hawthorne. New installations include a scientific research centre consisting of a six-story engineering building, an environmental test laboratory, jet-engine test cell, hypo-turbulence wind tunnel and other facilities, for research and development in the fields of guided missiles, advanced aircraft, atomic and nuclear energy.

In addition to its main factory at Hawthorne, the Northrop Division has facilities at El Segundo, Pasadena, Los Angeles International Airport and Edwards Air Force Base, California; Holloman Air Force Base, New Mexico; El Paso, Texas; and Cape Canaveral, Florida.

THE NORTHROP T-38.

Developed for two years as a private venture, the T-38 is now being built as a supersonic lightweight twin-jet trainer



The Northrop T-38 Supersonic Basic Trainer (two General Electric J85 turbojet engines).

for the U.S.A.F., under a contract awarded in May, 1956. The prototype is expected to fly late in 1958, powered by two General Electric J85 turbojets, and is intended to reproduce the flying characteristics of a supersonic operational fighter aircraft.

Intended as a replacement for the Lockheed T-33, the T-38 is an unswept mid-wing monoplane with the low-set "slab" tailplane associated with supersonic designs. Its fuselage is "waisted" in the region of the wing, in accordance with the area rule, and it seats two persons in tandem. The instructor's seat is raised to give him a forward view "over the shoulder" of the pupil. Special attention has also been paid to low initial and maintenance costs and the ability to operate from short runways.

TYPE.—Two-seat Supersonic Basic trainer.

WINGS.—Low-wing cantilever monoplane. Extremely-thin wing section. Moderate sweepback. All-metal structure. Fully-powered ailerons at approximately mid-span, with flaps inboard. No trim-tabs. Designed to be flown and landed safely using only one aileron.

FUSELAGE.—All-metal semi-monocoque structure with "waisted" area-rule lines. Two air-brakes on underside of fuselage forward of wheel wells. No braking parachute.

TAIL UNIT.—Cantilever monoplane type. All-metal construction. Fully-powered rudder and one-piece "all-moving" tailplane. No trim-tabs. Longitudinal and directional stability augmentors installed in series with control system.

LANDING GEAR.—Retractable tricycle type. Steerable nose-wheel.

POWER PLANT.—Two General Electric J85 (or Fairchild J83) turbojets with afterburners. Two independent fuel systems, one for each engine. Fuel for starboard engine provided by forward fuselage tank and dorsal tank just aft of rear cockpit. Fuel for port engine provided by centre and aft fuselage tanks. All tanks of bladder type.

ACCOMMODATION.—Pupil and instructor in tandem on ejection seats in pressurised and air-conditioned cockpit. Separate manually-operated, rearward-hingeing jettisonable canopies. Instructor's seat at rear raised 10 in. (0.25 m.) higher than that of pupil to give improved forward view.

DIMENSIONS.—
Span 25 ft. 3 in. (7.70 m.).
Length 43 ft. 0 in. (13.11 m.).
Height 11 ft. 11 in. (3.63 m.).

WEIGHT.—
Max. loaded weight 10,960 lb. (4,970 kg.).

PERFORMANCE (estimated).—
Max. speed (with afterburner) Mach 1.28 at 35,000 ft. (10,670 m.).

THE NORTHROP N-156F.

The N-156F is basically similar in design and construction to the T-38 supersonic trainer, but is equipped as a single-seat fighter. It is intended for both interception and ground attack duties from forward airstrips, and is fitted with a high-lift boundary layer control system, air load-actuated leading-edge slats and a parachute brake to make this possible. Each main landing gear unit is fitted with a wheel with oversize tyre, side-by-side with a teflon-surfaced skid which can be lowered by the pilot when required to give a greater bearing surface on soft ground. Zero-length take-off from a missile-type launching ramp is possible.

Power plant and powered flying controls are as for the T-38 and special attention has been paid to simple maintenance. The aft portion of the fuselage is removable to permit quick engine replacement, handling of the engines being facilitated by an overhead track and trolley arrangement in each engine bay. A self-contained cartridge-type starter is fitted. The hydraulic pump and generator and their engine-driven gear-box comprise a packaged unit mounted on the airframe structure.

The N-156F is designed to combine a performance comparable with that of current U.S.A.F. supersonic fighters with greatly-improved mobility and a reduction of more than 50% in take-off weight. It has provision for flight refuelling.

DIMENSIONS.—
Span with wing-tip armament 26 ft. 5 in. (8.05 m.).
Length 41 ft. 7½ in. (12.69 m.).
Height 13 ft. 0 in. (3.96 m.).

WEIGHT.—
Weight loaded 11,750 lb. (5,330 kg.).

PERFORMANCE (estimated).—
Max. speed above Mach 2.
Range with external tanks more than 1,950 miles (3,150 km.).

THE NORTHROP SCORPION.

U.S. Air Force designation: F-89.

The following are the principal versions of the F-89 Scorpion:—

F-89A. Two Allison J35-A-21 engines (4,900 lb.=2,225 kg. s.t. each) with afterburners. First production model. Armament consisted of six nose-mounted 20 mm. cannon.

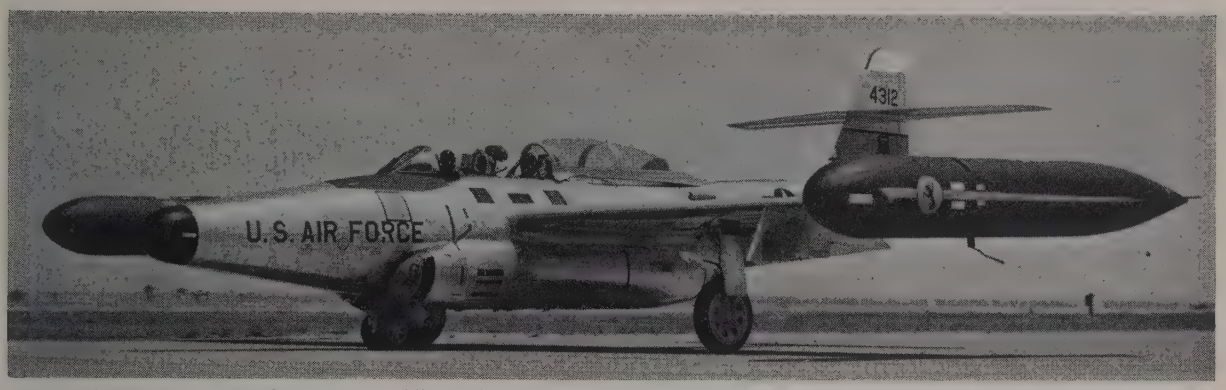
F-89B. Two Allison J35-A-33 engines (5,000 lb.=2,270 kg. s.t. each). Second production model. Generally similar to the F-89A but with certain internal and equipment changes.

F-89C. Two Allison J35-A-35 engines (5,600 lb.=2,540 kg. s.t. each). Progressive development of F-89B. External mass-balances on elevators suppressed.

F-89D. Two Allison J35-A-35 engines (5,600 lb.=2,540 kg. s.t. each) with Solar afterburners. Rocket-armament replaced the six 20 mm. nose-mounted cannon of earlier F-89 versions. A total of 104 2.75 in. folding-fin air-to-air rockets carried in permanently mounted wing-tip pods. Electronic aiming and automatic triggering equipment. Two droppable pylon-mounted underwing tanks equipped with Bohanan cartridge-type force ejectors for jettisoning. Additional fuel gives 11



The Northrop N-156F a Light Single-seat Tactica Fighter developed from the T-38.



The Northrop F-89H Scorpion All-weather Fighter (two Allison J35 turbojet engines). (*Gordon Williams*).

per cent. increase in range as compared with F-89C.

F-89H. Followed F-89D in production. Equipped with new electronic armament and has improved weapons capability. Details below refer to this version.

F-89J. This designation applies to earlier versions of F-89 brought up to F-89H standard.

The following description refers to the F-89H.

TYPE.—Twin-engined two-seat All-weather Interceptor Fighter.

WINGS.—Mid-wing cantilever monoplane. Thin-section high-lift low-drag wing-section. Thickness ratio 8½% at root, 7½% at tip. Taper ratio 2 : 1. Aspect ratio 4.5 : 1. Leading-edge sweep back 5°. All-metal multi-cellular structure. Double slotted flaps inboard of ailerons. The power-operated ailerons, or "decelerons," are split so as to serve as ailerons or dive-brakes. The upper and lower segments may be opened up and down simultaneously to serve as air brakes; or with the segments closed the surfaces operate as conventional ailerons. Hot-air anti-icing. Aileron area 45 sq. ft. (4.18 m.²). Flap area 63 sq. ft. (5.85 m.²). Gross wing area 562 sq. ft. (52.20 m.²).

FUSELAGE.—Oval section all-metal structure. Built in halves with joint along vertical centre-line, each half being equipped before assembly to central vertical keel which serves as mounting member for, and intervening firewall between, the two engines.

TAIL UNIT.—Cantilever monoplane type. All-metal structure. Power-operated control surfaces operated by aircraft hydraulic system, with emergency electrical actuation should hydraulic power fail. Tailplane span 11 ft. 6 in. (3.50 m.). Tailplane area 110 sq. ft. (10.22 m.²). Elevator area 25 sq. ft. (2.32 m.²). Vertical tail area (fin and rudder) 38 sq. ft. (3.53 m.²).

LANDING GEAR.—Retractable tricycle type. Main wheels are of large diameter and thin enough to permit total enclosure in wings when retracted. 165 lb./sq. in. tyre pressure. Steerable twin nose-wheels. Hydraulic retraction. Wheel track approx. 22 ft. (6.70 m.).

POWER PLANT.—Two Allison J35-A-35 turbojet engines, each with a static (dry) thrust rating of 5,450 lb. (2,474 kg.) and thrust with afterburner in use of 8,000 lb. (3,632 kg.). Engines may be lowered clear of mountings by built-in hydraulic hoist for ground level maintenance. Four lightweight Goodyear bullet-proof tanks in fuselage, twelve Goodyear Pliocel bladder tanks in wings and further fuel tankage in wing-tip pods. Under-wing pylon-mounted auxiliary fuel tanks with Bohanan cartridge type jettison equipment.

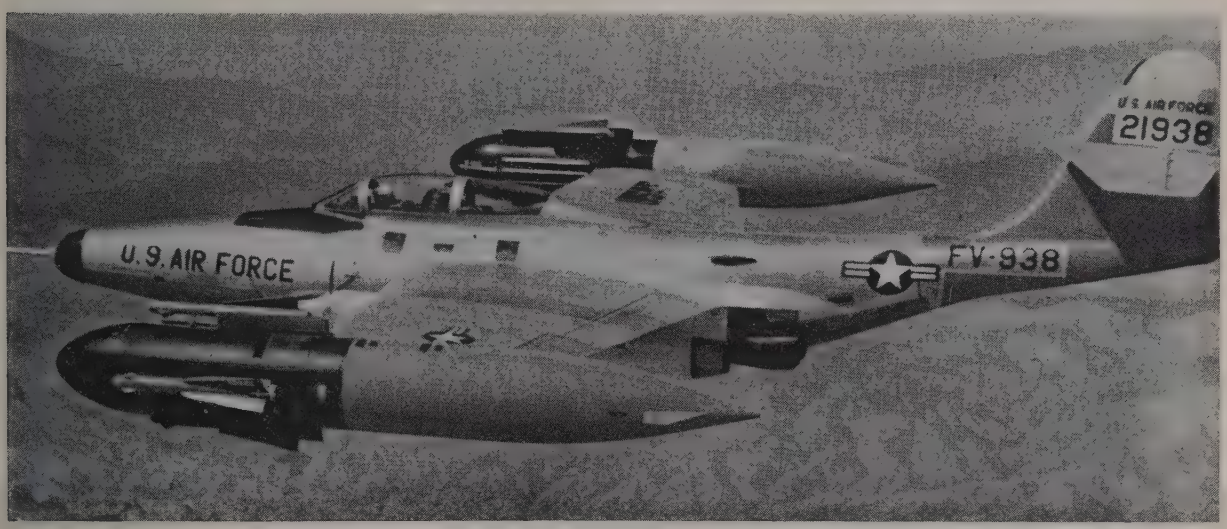
ACCOMMODATION.—Crew of two, pilot and radar operator, in tandem in pressurised cockpit. Power-operated jettisonable canopy and ejection seats. Cabin heating and refrigeration.

ARMAMENT.—Six Hughes GAR-1 Falcon air-to-air guided missiles, three in each wing-tip pod, and 42 × 2.75-in. rockets, 21 in each pod in clusters of seven behind frangible fairings. Can also carry MB-1 Genie air-to-air missile with nuclear warhead. Falcons and rockets can be fired selectively, the Falcons being extended clear of the pod on their launchers prior to firing. Automatic attack system includes sighting radar and fire control computer. Armament is triggered automatically.

DIMENSIONS.—
Span 59 ft. 8 in. (18.19 m.).
Length 53 ft. 4 in. (16.26 m.).
Height 17 ft. 7 in. (5.36 m.).

WEIGHTS.—
Loaded weight over 40,000 lb. (18,160 kg.).

PERFORMANCE.—
Max. speed over 600 m.p.h. (960 km.h.).
Operational ceiling over 50,000 ft. (15,250 m.).
Range over 1,000 miles (1,600 km.).



The Northrop F-89H Scorpion here seen with its six Falcon missiles in the extended firing position.

OAKLAND

OAKLAND AIRMOTIVE.

HEAD OFFICE AND WORKS: OAKLAND AIRPORT, OAKLAND, CALIFORNIA.

This company has developed an executive conversion scheme for the Lockheed PV-2 Harpoon naval patrol-bomber, and is marketing converted aircraft under the name of Oakland Centaurus. A description of the conversion follows.

THE OAKLAND CENTAURUS.

The Centaurus is a considerably-refined conversion of the Lockheed PV-2 Harpoon for executive use. The prototype is furnished with a divan, conference room, reclining seats and specially-designed mahogany cabinet work, but a wide variety of interiors is available to meet individual requirements. Seats can be provided for 8-14 passengers.

Many engineering changes have been incorporated. In particular, attention has been paid to improving the aerodynamic lines to achieve maximum performance. Large cabin windows are provided, and C.A.A. approval has been obtained for cabin pressurisation of up to 4.576 lb./sq. in. (0.32 kg./cm.²) if required, giving the equivalent of 8,000 ft. (2,440 m.) cabin pressure at 18,000 ft. (5,485 m.).

DIMENSIONS.—
Span 74 ft. (22.56 m.).
Length 54 ft. (16.46 m.).
Height 16 ft. (4.88 m.).

WEIGHTS.—
Weight empty 18,700 lb. (8,485 kg.).
Max. fuel (1,350 U.S. gallons = 5,105 litres) 8,815 lb. (4,000 kg.).
Passengers, baggage, optional equipment 5,485 lb. (2,485 kg.).
Weight loaded 33,000 lb. (14,970 kg.).

PERFORMANCE.—
Max. speed at S/L 328 m.p.h. (528 km.h.).
Cruising speed (55% power) at 10,000 ft. (3,050 m.) 280 m.p.h. (450 km.h.).

Stalling speed, undercarriage and flaps up 78 m.p.h. (126 km.h.).
Stalling speed, undercarriage and flaps down 69 m.p.h. (111 km.h.).
Rate of climb at S/L 2,000 ft./min. (610 m./min.).
Rate of climb at S/L one engine out 480 ft./min. (146 m./min.).
Take-off distance to clear 50 ft. (15.25 m.) at S/L 3,790 ft. (1,155 m.).
Range over 2,000 miles (3,220 km.).

OMEGA

OMEGA AIRCRAFT CORPORATION.

Head Office and Works: Municipal Airport, New Bedford, Massachusetts.

President and Chief Engineer: B. W. Sznycer.

Vice-President and Chief Test Pilot: R. L. Nields.

Vice-President: J. R. T. Du Pont.

Treasurer: Lloyd Lynd, Jr.

Secretary: A. Murray.

Omega Aircraft Corporation was formed in December, 1953, under the presidency of Mr. B. W. Sznycer, who had been responsible for the first certificated Canadian helicopter, the Sznycer-Gottlieb S.G. VI. Its first product, the Omega BS-12 Twin helicopter, flew for the first time on December 26, 1956, and is described hereafter.



The Omega BS-12-SC Twin with a simulated cargo pod slung amidships. (*Howard Levy*)

THE OMEGA BS-12-SC TWIN.

The Omega BS-12-SC Twin is a twin-engined helicopter which was developed on paper through Mark 1 and 2 stages, with the object of producing a prototype that would be unusually easy to service and would perform satisfactorily from the start of its flight testing. This appears to have been achieved, because the BS-12 flew for the first time on December 26, 1956, only 1½ hours after its construction was completed and has since completed a great deal of successful development flying.

A pre-series of five aircraft is being built for utility flying crane duties.

Type.—Twin-engined General-purpose helicopter.

Rotor System.—One four-blade main rotor, built up of two separate two-blade fully-articulated rotors splined one above the other to rotor shaft. Blades have laminated birch spar and spruce afterbody. All-steel friction dampers. Area of each blade 12.5 sq. ft. (1.16 m.²). Total disc area 1,194.6 sq. ft. (110.98 m.²). Two-blade seesaw-type tail anti-torque rotor of same construction as main rotor. Total disc area of tail rotor 41.2 sq. ft. (3.83 m.²).

Rotor Drive.—Both engines connected to a single gear-box through a flexible drive, in which the first-stage spur gear reduction on each engine is replaced by a 13-belt drive. Nylon-cored full-wedge type rubber belts. Centrifugal clutch in drive shaft from each engine engages at 1,350 r.p.m. through action of flywheel-mounted brake linings. Spiral jaw clutch disengages engine from drive in case of failure. Final drive from belt to rotor shaft through spiral bevel gear. Tail rotor driven by spiral bevel gear from transmission. Main rotor/engine r.p.m. ratio .1032. Tail rotor/engine r.p.m. ratio .44.

Fuselage.—Semi-monocoque cabin structure, attached to parallel-section steel-tube fuselage structure which is uncovered to facilitate maintenance. Fuselage breaks down aft of main landing gear into two sections, by removal of four bolts, for transport and repair.

Landing Gear.—Four-wheel non-retractable type. Electrol air-oil shock-absorbers with 12 in. (0.30 m.) travel. Struts for main gear designed also to support rear of cargo pannier, stretchers or other load carried under fuselage. Goodyear cast magnesium wheels. Main wheel tyres 6.00 × 6. Nose-wheel tyres 5.00 × 4. Tyre pressure 45 lb./sq. in. (3.16 kg./cm.²). Wheel track 12 ft. (3.66 m.). Wheel base 13 ft. (3.96 m.).

Power Plant.—Two Franklin 6VS-335 six-cylinder horizontally-opposed air-cooled engines, fitted with turbo-superchargers and each developing 225 h.p. for take-off. Engines mounted on steel-tube outrigger structures and completely accessible for servicing. Complete power plants can be removed as units on their mountings. Fuel in two mid-ship tanks with total capacity of 40 U.S. gallons (151.4 litres). Oil capacity 5½ U.S. gallons (21 litres).

Accommodation.—Enclosed cabin for pilot and passenger side-by-side in front and with bench-type seat for two or three persons to the rear. Controls entirely manual. Rear seats removable to provide 36 cub. ft. (1.02 m.³) cargo space. Four stretchers, crop-spraying gear, or up to 1,000 lb. (455 kg.) of cargo in container or net can be carried under rear fuselage, directly under rotor drive-shaft.

Dimensions.—
Main rotor diameter 39 ft. 0 in. (11.88 m.).
Tail rotor diameter 7 ft. 3 in. (2.20 m.).
Fuselage length 36 ft. (10.97 m.).
Height to top of rotor hub 13 ft. 0 in. (3.96 m.).
Tail rotor diameter 7 ft. 3 in. (2.21 m.).

Weights.—
Weight empty 3,125 lb. (1,417 kg.).
Weight loaded 4,565 lb. (2,070 kg.).

Performance.—
Max. speed at S/L 87.5 m.p.h. (141 km.h.).
Cruising speed at S/L (80% power) 78 m.p.h. (125.5 km.h.).
Rate of climb at S/L 1,000 ft./min. (305 m./min.).
Hovering ceiling in ground effect 4,800 ft. (1,460 m.).
Service ceiling 12,400 ft. (3,775 m.).
Endurance 2¾ hours.



A front view of the Omega BS-12-SC Twin Helicopter.

ON MARK

ON MARK ENGINEERING COMPANY.

Head Office and Works: 7,929 Hayvenhurst Avenue, Van Nuys Airport, Van Nuys, California.

Aircraft Coupling Division: 200, Avenue 64, Los Angeles 42, California.

President: Robert O. Denny.

Vice-Presidents: L. A. Keithley and W. H. Doheny.

Chief Engineer: Floyd Snow.

Secretary-Treasurer: Roy A. Wood.

This company was formed in 1954, when Mr. R. O. Denny and Mr. L. A. Keithley resigned from their former positions as President and Operations Manager respectively of Grand Central Aircraft Co. to start their own business. Since then, On Mark has outgrown two factories and is already planning for expansion of its newly-opened facilities at Van Nuys Airport.

Main work of On Mark since its formation has been modification, repair and overhaul of Douglas B-26 aircraft. This has included the complete re-manufacture of B-26 airframes to convert them into high-speed civilian executive transports. In addition, On Mark is the exclusive licensee of Douglas Aircraft Company, Inc., in the production of spare parts for the B-26, and holds U.S.A.F. contracts for overhauling components such as hydraulic units, control surfaces and exhaust systems.

In 1957 it was announced that the

company was building the prototype of a twin-turboprop pressurised executive transport of its own design, known as the Model 450 Marksman, but no recent news of this aircraft has been forthcoming.

THE ON MARK EXECUTIVE.

The On Mark Executive is a completely remanufactured Douglas B-26 bomber, powered by two Pratt & Whitney R-2800-75/79 or R-2800-CB 16 engines and furnished luxuriously to the customer's specification. It carries a useful load of 12,000 lb. (5,443 kg.), which can include up to 11 passengers, a crew of two, an internal fuel load of 1,235 U.S. gallons (4,673 litres) and up to 3,500 lb. (1,588 kg.) of baggage and freight. Wing-tip fuel tanks, each with a capacity of 165 U.S. gallons (622 litres), are available for increased ranges of up to 2,700 miles (4,345 km.).

A description of the basic B-26 airframe has appeared in previous editions of "All the World's Aircraft." On Mark modifications in the executive version include the fitting of double-glass cabin windows, sound-proofing and insulation, a hydraulically-operated self-contained entrance stairway under the fuselage or on starboard side of cabin, a baggage compartment in the nose, disc brakes, dual controls and full instrumentation and radio. Reversible-pitch airscrews are available, if specified.

PERFORMANCE.—
Cruising speed (R-2800-CB16 engines, 62% power) 365 m.p.h. (587 km.h.).
Cruising speed (R-2800-75/79 engines, 62% power) 315 m.p.h. (507 km.h.).
Normal range over 2,100 miles (3,380 km.).
Max. range 2,700 miles (4,345 km.).

PIASECKI

PIASECKI AIRCRAFT CORPORATION.

HEAD OFFICE AND WORKS: ISLAND ROAD, INTERNATIONAL AIRPORT, PHILADELPHIA 42, PA.

DELAWARE DIVISION: BELLANCA AIRPORT, NEW CASTLE, DELAWARE.

President: Frank N. Piasecki.

Vice-President, Engineering: Donald N. Meyers.

The Piasecki Aircraft Corporation was formed in 1955 by Mr. Frank Piasecki, who was formerly Chairman of the Board and President of the Piasecki Helicopter Corporation (now renamed Vertol Aircraft Corporation, which see).

In November, 1956, the new Piasecki Aircraft Corporation expanded its facilities by acquiring the 330-acre plant, machinery and other physical assets of the Aircraft Division of the Bellanca Corporation. This plant is operated as Piasecki's Delaware Division.

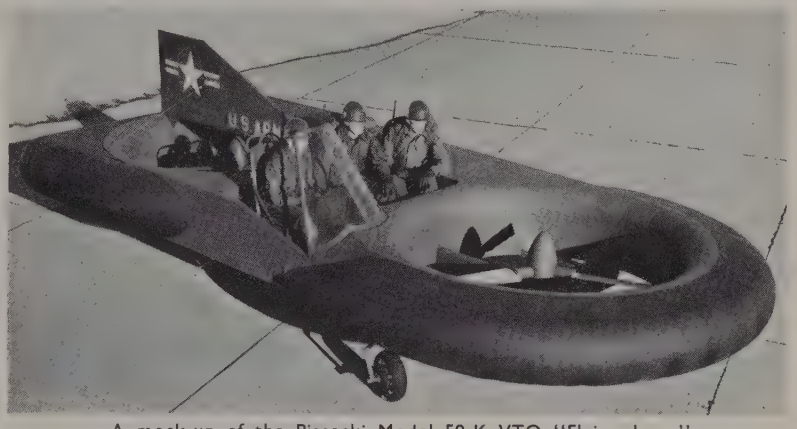
The Piasecki company is engaged in all phases of vertical lift research and development, and at the time of writing held twelve prime contracts from the U.S. Army and Navy, of which six were secret.

The contracts include one from the Navy to design, ground test and wind tunnel test a new type of vertical lift aircraft which combines the versatility of the helicopter with the capabilities of high level-flight speeds. Covered by the designation of PA-2C, this aircraft is being designed primarily for operation from aircraft carriers, cruisers, destroyers and unprepared land areas, but has civilian applications. No details are available except that it takes off in a horizontal attitude, can hover and fly backwards, is multi-engined and would fly, glide and land safely under full control with one engine out or after a complete power plant failure.

Another Naval contract is for the design and construction of an unmanned, remotely-controlled vertical lift aircraft known as the PA-4A "Sea Bat." Small enough to be operated from restricted areas on small warships and to be stowed on board submarines, the "Sea Bat" is intended to be operated under electronic control on duties that would be difficult or impossible to carry out without high probability of serious loss to conventional fixed-wing aircraft or helicopters and their crews. It will be able to hover and fly quickly in any direction.

No details of the "Sea Bat" are yet available, except that the prototype had been completed and was undergoing tethered flight tests in the Spring of 1958.

In March, 1958, details were released of the Model 59-K vertical take-off "flying jeep" developed by Piasecki for the U.S. Army, and a description of this aircraft is given below.



A mock-up of the Piasecki Model 59-K VTO "Flying Jeep."

Piasecki is working on advanced designs of "flying crane" helicopters under contract from the U.S. Army's Transportation Corps' Research and Development Command. Aim of this programme is to produce a heavy lift design capable of carrying up to 16 tons of cargo for distances up to 100 miles (160 km.).

In addition, the company has a Transportation Corps contract to design, manufacture and flight test a radically-new low-vibration, low-maintenance helicopter rotor that will greatly reduce the initial and operating costs of rotating-wing aircraft. Intended specifically to replace the existing rotors of the Vertol H-25 helicopter, but applicable to other types, the new design eliminates many parts in the present assembly of rotor blades and their attachment to the drive shaft and 80% of the bearings in the present hinge-assembly.

Only other contract that can be mentioned is for engineering research on a minesweeping system for the U.S. Navy.

Early in 1958, Piasecki signed a technical interchange agreement with Ateliers d'Aviation Louis Breguet of Paris, France. Under the terms of this agreement, the two companies will share specific aircraft designs, production techniques, and research, engineering and test facilities.

THE PIASECKI MODEL 59-K.
U.S. Army designation: VZ-8P.

The Piasecki Model 59-K is a new type of vertical take-off aircraft which derives its lift from two horizontal three-blade rotors enclosed in ducts, one at the front and one at the rear. The rotors are shielded completely on all sides, which eliminates the usual danger of unprotected rotors, and are driven by two 180 h.p. Lycoming O-360-A2A engines. The drive-shafts are so arranged that either engine can drive both rotors after failure of the other. The engines, and seats for the pilot and three passengers, are mounted between the rotor ducts. All components are housed in the low flat chassis, which is carried on three wheels to provide ground manoeuvrability.

Intended for military observation, liaison and other duties, the Piasecki 59-K is designed to fly close to the ground on normal missions, taking advantage of all natural cover. However, it is claimed to be capable of flying high enough to cross over most of the mountainous terrain in the United States and of flying at a forward speed of more than 150 m.p.h. (240 km.h.).

To determine the efficiency of the rotor system, and the stability and control characteristics of the design, initial ground tests were made with a full-scale, full-power test unit on a strain-gauged balance rig, mounted on the bed of a large trailer truck. This work had been completed to the satisfaction of the U.S. Army Transportation Research and Engineering Command by the Spring of 1958.

Two flying prototypes are being built under the present Army contract, and the first of these became airborne for the first time on October 12, 1958.

Piasecki plans to develop a civilian version of the Model 59-K, with powered wheels for movement on the ground, an enclosed cabin seating four persons side-by-side, safety grilles over the rotors and night-flying equipment. This version will be known as the Sky-Car.

PIPER

THE PIPER AIRCRAFT CORPORATION.

HEAD OFFICE AND WORKS: LOCK HAVEN, PENNSYLVANIA.

President and Chairman of the Board: W. T. Piper, Sr.

Executive Vice-President: W. T. Piper, Jr.

Vice-President in charge of Operations: Thomas F. Piper.

Vice-President in charge of Research and Development: Howard Piper.

Chief Engineer: W. C. Jamouneau.

The Piper Aircraft Corporation is now manufacturing the PA-24 Comanche, a four-seat single-engined high-performance executive aircraft; the PA-23 Apache, a twin-engined executive aircraft for four passengers; the PA-22 Tri-Pacer; the Super Cub; and the PA-18-A agricultural version of the Super Cub 150.

The entirely-new Piper Comanche four-seat executive low-wing monoplane made its first flight on May 24, 1956, and the first production aircraft flew on October 21, 1957.

The Piper Aircraft Development Centre at Vero Beach, Florida, which began work in 1957, is responsible for the design, construction and test flying of experimental prototypes of future Piper aircraft. One of the first types sent there for evaluation was the Piper-sponsored Ag-3 agricultural aircraft built at the Texas A. and M. College.

Sub-contracting activities include considerable work for both jet aircraft and helicopter manufacturers.

Piper Aircraft Corporation still leads in World sales of light aircraft.



The Piper PA-24 Comanche (180 h.p. Lycoming O-360 engine).

THE PIPER PA-24 COMANCHE.

TYPE.—Four-seat cabin monoplane.

WINGS.—Low-wing cantilever monoplane. NACA 64^2 A215 laminar-flow wing section. Aspect ratio 7.20. Mean chord 5 ft. (1.52 m.). Dihedral 5°. Incidence 2°. Single-spar all-metal structure. Differentially-operated metal-covered ailerons. Plain all-metal flaps. Total aileron area 14.1 sq. ft. (1.31 m.²). Total flap area 20.2 sq. ft. (1.87 m.²). Gross wing area 178 sq. ft. (16.53 m.²).

FUSELAGE. — All - metal semi - monocoque structure.

TAIL UNIT.—Cantilever monoplane. All-metal "All-flying" tail or stabilator. Sweptback fin and rudder. Areas: fin 8 sq. ft. (0.74 m.²), rudder 5.4 sq. ft. (0.52 m.²), stabilator 32.5 sq. ft. (3.04 m.²). Span of tail 12 ft. 6 in. (3.81 m.).

LANDING GEAR.—Retractable nose-wheel type. Electric with emergency manual retraction. Piper oleo-pneumatic shock absorbers. Cleveland disc brakes. Wheel base 6 ft. 6⅝ in. (1.98 m.). Track 9 ft. 9 in. (2.97 m.).

POWER PLANT.—One 180 h.p. Lycoming O-360-A1A, or 250 h.p. Lycoming O-540-A1A, engine. Hartzell constant-speed air-screw. Two internal wing tanks. Total fuel capacity 60 U.S. gallons (227 litres).

ACCOMMODATION.—Enclosed cabin seating four in two pairs. Dual controls.

DIMENSIONS.—
Span 36 ft. (11 m.).
Length 24 ft. 9 in. (7.5 m.).
Height 7 ft. 5 in. (2.25 m.).

WEIGHTS (180 Lycoming O-360 engine).—
Weight empty 1,475 lb. (670 kg.).
Disposable load 1,075 lb. (487 kg.).
Weight loaded 2,550 lb. (1,157 kg.).

WEIGHTS (250 h.p. Lycoming O-540 engine).—
Weight empty 1,600 lb. (726 kg.).
Disposable load 1,200 lb. (545 kg.).
Weight loaded 2,800 lb. (1,271 kg.).

PERFORMANCE (180 h.p. Lycoming O-360 engine).—
Max. speed 167 m.p.h. (267 km.h.).
Cruising speed 150 m.p.h. (240 km.h.).
Stalling speed (flaps down) 61 m.p.h. (97.6 km.h.).
Rate of climb at S/L 910 ft./min. (277 m./min.).
Service ceiling 18,500 ft. (5,640 m.).
Cruising range 705 miles (1,128 km.).

PERFORMANCE (250 h.p. Lycoming O-540 engine).—
Max. speed 190 m.p.h. (304 km.h.).
Cruising speed 171 m.p.h. (274 km.h.).
Stalling speed (flaps down) 64 m.p.h. (102.4 km.h.).
Rate of climb at S/L 1,400 ft./min. (427 m./min.).
Service ceiling 20,000 ft. (6,100 m.).
Cruising range 705 miles (1,128 km.).



The Piper PA-23 Apache (two 150 h.p. Lycoming O-320 engines).

THE PIPER PA-23 APACHE.

TYPE.—Four/five-seat cabin monoplane.

WINGS.—Low-wing cantilever monoplane. U.S.A. 35-B (modified) wing section. Aspect ratio 6.8. Chord 5 ft. 7 in. (1.70 m.). Dihedral 5°. All-metal structure. Frise type all-metal ailerons and flaps. Total aileron area 8.375 sq. ft. (0.77 m.²). Gross wing area 204 sq. ft. (18.95 m.²).

FUSELAGE.—All-metal structure.

TAIL UNIT.—Cantilever monoplane type. All-metal. Areas: fin 10.75 sq. ft. (1.00 m.²), rudder 9.75 sq. ft. (0.90 m.²), elevators (total) 16.6 sq. ft. (1.54 m.²), tailplane 23.6 sq. ft. (2.19 m.²).

LANDING GEAR.—Retractable nose-wheel type. Hydraulic retraction, with emergency pneumatic operation. Electrol hydraulic shock-absorber struts. Goodrich wheels. Hydraulic brakes. Wheel-base 7 ft. 6 in. (2.28 m.). Track 11 ft. (3.35 m.).

POWER PLANT.—Two 150 h.p. or 160 h.p. Lycoming O-320 four-cylinder horizontally-opposed air-cooled engines. Hartzell two-blade constant-speed full-feathering air-screws, 6 ft. 4 in. (1.93 m.) diameter. Two rubber-cell fuel tanks, one in each wing. Total normal fuel capacity 72 U.S. gallons (272 litres). Two additional tanks (18 U.S. gallons = 68 litres each) can be installed outboard of standard wing tanks.

ACCOMMODATION.—Enclosed cabin with standard seating for four in two pairs, with dual controls to front pair. Cabin can be readily adapted for the fitting of an extra seat at rear of cabin. Normal capacity for 12½ cub. ft. (0.35 m.³) baggage. Full instrumentation and sound-proofing. Omni radio, VHF, LF and automatic D/R equipment.

DIMENSIONS.—
Span 37 ft. 1⅜ in. (11.32 m.).
Length 27 ft. $4\frac{5}{16}$ in. (8.34 m.).
Height 9 ft. 6 in. (2.87 m.).

WEIGHTS AND LOADINGS (2 × 150 h.p. Lycoming engines).—
Weight empty 2,215 lb. (1,006 kg.).
Passengers (4) 680 lb. (309 kg.).
Fuel and oil 462 lb. (210 kg.).
Weight loaded 3,500 lb. (1,590 kg.).
Wing loading 17.2 lb./sq. ft. (83.94 kg./m.²).
Power loading 11.6 lb./h.p. (5.26 kg./h.p.).

WEIGHTS AND LOADINGS (2 × 160 h.p. Lycoming engines).—
Weight empty 2,230 lb. (1,012 kg.).
Weight loaded 3,800 lb. (1,725 kg.).
Wing loading 18.6 lb./sq. ft. (90.76 kg./m.²).
Power loading 11.9 lb./h.p. (5.40 kg./h.p.).

PERFORMANCE (2 × 150 h.p. Lycoming engines).—
Max. speed 180 m.p.h. (288 km.h.).
Cruising speed at 6,000 ft. (1,830 m.) 170 m.p.h. (272 km.h.).
Stalling speed (wheels and flaps down) 59 m.p.h. (94.4 km.h.).
Initial rate of climb 1,350 ft./min. (412 m./min.).
Rate of climb on one engine 240 ft./min. (93 m./min.).
Absolute ceiling 20,000 ft. (6,100 m.).
Single-engine ceiling 6,750 ft. (2,060 m.).
Cruising range (75% power at S/L, with auxiliary tanks) 930 miles (1,490 km.).
Max. range with additional fuel tanks 1,260 miles (2,016 km.).
Take-off run 990 ft. (302 m.).
Landing run 670 ft. (204 m.).

PERFORMANCE (2 × 160 h.p. Lycoming engines).—
Max. speed 183 m.p.h. (293 km.h.).
Cruising speed at 6,000 ft. (1,830 m.) 171 m.p.h. (274 km.h.).
Stalling speed (power off, flaps down) 61 m.p.h. (98 km.h.).
Initial rate of climb 1,260 ft./min. (384 m./min.).
Rate of climb on one engine 180 ft./min. (55 m./min.).
Service ceiling 17,000 ft. (5,185 m.).
Single-engine ceiling 5,500 ft. (1,680 m.).
Cruising range 720 miles (1,150 km.).
Max. range with additional fuel 1,070 miles (1,712 km.).
Take-off run 1,190 ft. (363 m.).
Landing run 750 ft. (228 m.).

THE PIPER PA-22 TRI-PACER.

TYPE.—Four-seat Cabin monoplane.

WINGS.—High-wing braced monoplane. Wing



The Piper PA-22 Tri-Pacer 160 (160 h.p. Lycoming O-320 engine).

section US-35B (modified). Chord 5 ft. 3 in. (1.60 m.). Wing structure consists of two I-section aluminium spars, riveted Nicral ribs and a covering of Duroclad, a non-inflammable Butyrate-plastic-treated fabric of high-gloss finish. Flaps inboard of ailerons. Wing area 147.5 sq. ft. (13.7 m.²).

FUSELAGE.—Rectangular welded steel-tube structure covered with Duroclad.

TAIL UNIT.—Braced monoplane type. Same structure as for PA-18.

LANDING GEAR.—Fixed nose-wheel type. Two side Vees and half axles hinged to centre-line of underside of fuselage. Hydrasorb shock-absorbers. Hydraulic wheel brakes. Steerable nose-wheel interconnected with rudder for ground steering. Certified for floats and skis.

POWER PLANT.—One 150 h.p. or 160 h.p. Lycoming O-320 four-cylinder horizontally-opposed air-cooled engine. Two-blade Sensenich metal fixed-pitch airscrew, diameter 6 ft. 4 in. (1.93 m.). Fuel capacity 36 U.S. gallons (136 litres). Additional 8 U.S. gallon (30 litres) auxiliary tank optional.

ACCOMMODATION.—Cabin seats four in two pairs with dual controls to front pair. Front and rear doors, front door on starboard side and rear door on port side. Soundproofing, cabin heating and temperature control. Ultra-violet-absorbing Plexiglas windows. Compartment for 100 lb. (45 kg.) baggage. Cabin equipment varies according to model. Narco two-way VHF and LF radio or automatic direction-finding and omni equipment in Custom model.

DIMENSIONS.—
Span 29 ft. 3⅛ in. (8.9 m.).
Length 20 ft. 8⅞ in. (6.32 m.).
Height 8 ft. 4 in. (2.54 m.).

WEIGHTS AND LOADINGS.—
Weight empty 1,100 lb. (500 kg.).
Disposable load 900 lb. (408 kg.).
Weight loaded 2,000 lb. (908 kg.).
Wing loading 13.5 lb./sq. ft. (65.88 kg./m.²).
Power loading (150 h.p.) 13.3 lb./h.p. (6.03 kg./h.p.).
Power loading (160 h.p.) 12.5 lb./h.p. (5.67 kg./h.p.).

PERFORMANCE (150 h.p. Lycoming engine).—
Max. speed 139 m.p.h. (222 km.h.).
Cruising speed (75% power at S/L.) 123 m.p.h. (197 km.h.).
Optimum cruising speed (75% power at 7,000 ft.=2,135 m.) 132 m.p.h. (211 km.h.).
Stalling speed (flaps extended) 49 m.p.h. (78.4 km.h.).
Rate of climb at S/L. 725 ft./min. (221 m./min.).
Service ceiling 15,000 ft. (4,575 m.).
Absolute ceiling 17,500 ft. (5,340 m.).
Range with normal tankage over 500 miles (800 km.).
Max. range with auxiliary tank over 600 miles (960 km.).

PERFORMANCE (160 h.p. Lycoming engine).—
Max. speed 141 m.p.h. (226 km.h.).
Cruising speed 125 m.p.h. (200 km.h.).
Optimum cruising speed (at 7,000 ft.=2,135 m.) 134 m.p.h. (214 km.h.).

THE PIPER PA-18 SUPER CUB "150".

TYPE.—Two-seat Light Cabin monoplane.

WINGS.—High-wing braced monoplane. Wing structure of aluminium spars and aluminium-alloy ribs, the whole being covered with Duroclad. Steel-tube Vee bracing struts. Wing flaps. Gross wing area 178.5 sq. ft. (16.58 m.²).



The Piper PA-18 Super Cub 150 (150 h.p. Lycoming O-320 engine).

FUSELAGE.—Rectangular welded steel-tube structure covered with Duroclad.

TAIL UNIT.—Braced monoplane type. Welded steel-tube framework covered with Duroclad. Tailplane span 10 ft. 6 in. (3.20 m.).

LANDING GEAR.—Fixed divided type. Two side Vees and half axles hinged to cabane below fuselage. Rubber cord shock absorption. Hydraulic wheel-brakes. Leaf-spring steerable tail-wheel. Edo standard or amphibious floats may be fitted.

POWER PLANT.—One 150 h.p. Lycoming O-320 four-cylinder horizontally-opposed air-cooled engine on swinging engine mounting. Two-blade wood or metal airscrew. Fuel capacity 36 U.S. gallons (136 litres).

ACCOMMODATION.—Enclosed cabin seating two in tandem with dual controls. Large door on right side and sliding windows on left. Baggage compartment aft of rear seat. Equipment may be installed for spraying, dusting, fertilising, etc.

DIMENSIONS.—
Span 35 ft. 2½ in. (10.72 m.)
Length 22 ft. 6 in. (6.86 m.).
Height 6 ft. 7 in. (2.00 m.).

WEIGHTS AND LOADINGS.—
Weight empty 930 lb. (422 kg.).
Disposable load 820 lb. (372 kg.).
Weight loaded 1,750 lb. (794 kg.).
Wing loading 10 lb./sq. ft. (48.8 kg./m.²).
Power loading 11.6 lb./h.p. (5.26 kg./h.p.).

PERFORMANCE.—
Max. speed 130 m.p.h. (208 km.h.).
Cruising speed (75% power) 115 m.p.h. (184 km.h.).
Stalling speed (with flaps) 43 m.p.h. (68.8 km.h.).
Best rate of climb 950 ft./min. (290 m./min.).
Service ceiling 19,000 ft. (5,795 m.).
Take-off run 200 ft. (61 m.).
Take-off distance to 50 ft. (15.25 m.) 500 ft. (152.5 m.).
Landing run 350 ft. (107 m.).
Cruising range 460 miles (735 km.).

THE PIPER PA-18 SUPER CUB "95".

The Super Cub "95" is identical to the "150" except that it is powered by the 90 h.p. Continental C90 engine and is not fitted with wing flaps.

DIMENSIONS.—
Same as for Super Cub "150" except :—
Length 22 ft. 4½ in. (6.82 m.).

WEIGHTS AND LOADINGS.—
Weight empty 800 lb. (363 kg.).
Disposable load 700 lb. (317 kg.).
Weight loaded 1,500 lb. (680 kg.).
Wing loading 8.4 lb./sq. ft. (50 kg./m.²).
Power loading 16.6 lb./h.p. (7.53 kg./h.p.).

PERFORMANCE.—
Max. speed 110 m.p.h. (176 km.h.).
Cruising speed 100 m.p.h. (160 km.h.).
Stalling speed 42 m.p.h. (67.2 km.h.).
Rate of climb at S/L. 624 ft./min. (190 m./min.).
Service ceiling 13,500 ft. (4,120 m.).
T.O. run 452 ft. (138 m.).
T.O. to clear 50 ft. (15.25 m.) 952 ft. (290 m.).
Landing run 385 ft. (117 m.).

THE PIPER PA-18-A.

This version of the Super Cub is primarily an agricultural sprayer/duster, but it is adaptable for normal uses. It is quantity produced with Piper designed and installed agricultural dispersal equipment as an integral part of the aircraft.

The fuselage has been modified to accommodate an 18 cub. ft. aluminium tank which has a capacity for 110 U.S. gallons of liquid or from 500 to 1,000 lb. of solids, depending on the specific gravity of material used. Every unit has a maximum output of 35 gallons per minute and a pressure range of from 10 to 110 lb., depending on the nozzle orifice and pressure regulator setting.

For dust distribution, an agitator in the hopper and, below the fuselage, a slotted venturi with double gates and lateral dispersal plates ensure uniform flow over a 50 ft. swath.

The normal spray booms are fitted with 24 diaphragm type nozzles which give instant positive shut-off. The booms are hinged to fold back and up about 80° to reduce impact loads if they hit an obstacle.

A new Piper high-density sprayer is also available which will permit the application of from 1 to 10 gallons per acre for a full 50 ft. swath, or 10 to 15 gallons if the swath is cut to 33 ft. This equipment incorporates 46 nozzles on the boom, a new large Simplex pump mounted under the nose cowling and larger outlet and return pipes from the tank to the pump. This high-density unit was designed primarily for de-foliating irrigated cotton and now has many new uses.

Safety features include sharpened leading-edges on the landing-gear struts to cut wires, etc., heavy duty safety belt and shoulder harness for the pilot, etc.

The 1958 PA-18-A is powered by the 150 h.p. Lycoming O-320 engine.

DIMENSIONS.—Same as for Super Cub.

WEIGHTS AND LOADINGS (Sprayer or Duster).—
Weight empty 960 lb. (436 kg.).
Disposable load 1,110 lb. (504 kg.).
Weight loaded (max. permissible) 2,070 lb. (940 kg.).
Wing loading 11.6 lb./sq. ft. (56.6 kg./m.²).
Power loading 13.8 lb./h.p. (6.62 kg./h.p.).



The Piper PA-18-A Agricultural Sprayer/Duster.

PERFORMANCE (at 2,070 lb. = 940 kg. A.U.W.).—
Max. speed 128 m.p.h. (205 km.h.).
Cruising speed (75% power) 113 m.p.h. (181 km.h.).
Stalling speed (flaps down) 45 m.p.h. (72 km.h.).
Rate of climb 760 ft./min. (232 m./min.).
Service ceiling 17,000 ft. (5,185 m.).
Take-off distance to 50 ft. (15.25 m.) 950 ft. (290 m.).
Landing distance from 50 ft. (15.25 m.) 875 ft. (267 m.).

RADIOPLANE

RADIOPLANE DIVISION, NORTHROP AIRCRAFT, INC.

HEAD OFFICE: 8000, WOODLEY AVENUE, VAN NUYS, CALIFORNIA.

OTHER WORKS: EL PASO, TEXAS.

President: Whitley C. Collins.

Vice-President, General Manager: M. W. Tuttle.

Vice-President, Administration: H. E. Riggins, Jr.

Vice-President, Customer Relations: F. H. Crank.

Vice-President, Engineering: S. E. Weaver.

Vice-President, Manufacturing: P. I. Chase.

Assistant Vice-President and Director, Export Requirements: A. W. Callam.

Assistant Vice-President, Development Planning: William Patterson.

Assistant Vice-President, Engineering: John R. Jacobsen.

Secretary-Treasurer: Joseph Corie.

The Radioplane Division of Northrop Aircraft Inc., designs and manufactures missiles, pilotless target aircraft and related equipment, such as catapults and other ground support gear.

The Radioplane Division undertook the design, development and construction of its first radio-controlled aircraft target nineteen years ago. Since then the company has expanded to become a leader in the field of pilotless aircraft. Over 45,000 Radioplane target drones have been delivered to the U.S. military services and the company has also been awarded a major contract to provide target flight service for U.S. Army surface-to-air missile training at Fort Bliss, Texas. The contract requires not only provision of targets and ground support gear, but operational, training and maintenance personnel as well.

Beginning in 1935, a series of experimental drones was developed and the first production model (OQ-2A) was delivered in that year. The OQ-2A had a 6½ h.p. engine and cruised at 88 m.p.h. (141 km.h.). The current Radioplane target drone, the OQ-19, has a 72 h.p. engine, a level flight speed of 227 m.p.h. (363 km.h.) and is capable of climbing 2,400 ft./min. (730 m./min.) to a service ceiling of 23,000 ft. (7,010 m.).

Deliveries of the new rocket-powered XKD4R-1 target drones have been made to the U.S. Navy's Air Missile Test Center at Point Mugu, California, for evaluation as air-to-air fleet training targets.

In addition to target drone work, Radioplane is participating in classified research and development programmes for the U.S.A.F. and U.S. Navy. Under U.S.A.F. contract is advanced development of the Crossbow missile system and the supersonic X-4A, an advanced turbojet-powered target drone which will be used to evaluate weapon systems.

Since 1943 Radioplane has been engaged in research and development on parachute deceleration and recovery problems, and in the design, development and manufacture of missile recovery systems.



The Radioplane RP-70 (XKD4R-1) Rocket-powered Missile Target.

THE RADIOPLANE XQ-4.

The XQ-4 is a supersonic target drone for the evaluation of weapons systems.

Designed to exceed considerably the performance of all currently-operational target drones, the radar-controlled XQ-4 has a long small-diameter fuselage, short straight wings and an underslung turbojet engine installation. It is air-launched and is recoverable by three-stage parachute over land or water.

The XQ-4 is powered by a Westinghouse J81 turbojet and is radar-controlled. Provision is made for accommodating special tracking, scoring and photographic or television reconnaissance equipment.

Several highly successful test flights of the XQ-4 have been made at Holloman Air Force Base, New Mexico. An advanced version, designated XQ-4A is under development.

DIMENSIONS (approx.).—
Span 12 ft. (3.66 m.).
Length 35 ft. (10.67 m.).
Diameter of fuselage 2 ft. (0.61 m.).
PERFORMANCE.—
Ceiling over 60,000 ft. (18,290 m.).

THE RADIOPLANE RP-70.
U.S. Navy designation: XKD4R-1.

Now under evaluation by the U.S. Navy, the XKD4R-1 is intended to provide target practice for air-to-air missiles and is capable of Mach 0.9 at 50,000 ft. (15,250 m.). It is powered by a solid-propellent rocket which exhausts through dual nozzles in the sides of the fuselage just aft of the wings, and has an endurance of 8-10 minutes.

The airframe, which weighs 300 lb. (136 kg.), is designed for high volume production. With the exception of the steel rocket motor case, which forms the mid section of the fuselage, all other primary structures are of glass-fibre reinforced plastic.

The wings and horizontal and vertical tail surfaces are fixed surfaces. Control of the drone is accomplished by small canard vanes located just forward of the wing and linked directly to the pre-set flight control system. This system and the control surfaces are built up as a single compact removable unit.

The XKD4R-1 is designed for air-launching and is fitted with radar augmentation devices to give it the appearance of a conventional piloted fighter aircraft on a radar screen. Its payload capabilities are sufficient to enable it to carry special tracking and scoring equipment.

DIMENSIONS.—
Span 5 ft. (1.52 m.).
Length 9 ft. (2.74 m.).

THE RADIOPLANE OQ-19 and KD2R.
U.S. Air Force and Army designations: OQ-19B and OQ-19D.
U.S. Navy designation: KD2R-5.

This aerial target is currently in use by the U.S. Air Force, Army Field Forces and the U.S. Navy as a training device for ground-to-air gunnery and missile firing. It is powered by a McCulloch O-100-1 four-cylinder two-stroke air-cooled engine rated at 72 h.p. at 4,150 r.p.m.

The target is launched from a Radioplane A-7 catapult, is remotely controlled by radio, tracked visually (OQ-19D) or by radar (OQ-19B and KD2R-5), and, after the completion of its mission, is recovered by the use of a radio-released 38 ft. (11.6 m.) parachute. In the event of serious damage by gunfire or loss of radio control, the parachute is deployed automatically. The target is of aluminium-alloy construction and is easily repaired if damaged by gunfire.

DIMENSIONS.—
Span (without pods) 11 ft. 6 in. (3.50 m.).
Length 12 ft. 3 in. (3.74 m.).
WEIGHT.—
Ready for flight 317 lb. (144 kg.).
PERFORMANCE.—
Max. speed at S/L 227 m.p.h. (363 km.h.).



The Radioplane OQ-19B (72 h.p. McCulloch O-100 engine).

Rate of climb 2,400 ft./min. (730 m./min.)
Service ceiling 23,000 ft. (7,010 m.).
Endurance at S/L 1 hour.

THE RADIOPLANE RP-71.
U.S. Army designation: SD-1.

The RP-71F photo surveillance drone was developed for the U.S. Army Signal Corps as a short-range battlefield surveillance device. Launched from a zero-length launcher, controlled remotely by radio and tracked by radar, the RP-71F carries a still or ciné camera for surveillance over hostile territory. On reaching a predetermined recovery area the controller who has guided its flight commands parachute recovery.

Power is provided by a 72 h.p. McCulloch O-100-1 four-cylinder opposed air-cooled engine, and fuel is carried for an endurance of 30 minutes at sea level.

DIMENSIONS.—
Span (over reflector pods) 13 ft. 2 in. (4.0 m.).
Length 13 ft. 2 in. (4.0 m.).

PERFORMANCE.—
Speed 184 m.p.h. (294 km.h.) at S/L.
Altitude 15,000 ft. (4,575 m.).
Endurance 30 min. at S/L.



The Radioplane RP-71 (SD-1) on its combination transport trailer/launcher.

THE RADIOPLANE RP-76.

The RP-76 is a high-performance, solid-rocket, radio-controlled recoverable, target missile for the training of ground-to-air missile crews. The target is carried to altitude by either an F-89 Scorpion fighter or by another Radioplane development, the RP-77DL turboprop-powered radio-controlled drone carrier. The rocket target carries a burst-distance indicator system which relays "hit" information to a ground data station. Recovery is by a two-stage parachute.

DIMENSIONS.—
Span 5 ft. (1.525 m.).
Length 9 ft. 8 in. (2.95 m.).
Fuselage diameter 1 ft. 3 in. (0.38 m.).

PERFORMANCE.—
Speed Mach 0.9.
Altitude 60,000 ft. (18,300 m.).
Endurance 9-10 min.



The Radioplane RP-76 Nike-Ajax target on its handling dolly.

THE RADIOPLANE RP-77D.

The RP-77D is a radio-controlled turboprop-powered aerial target which has been developed for the U.S. Army. It is intended as a target for surface-to-air and air-to-air gunnery, for rocket and missile firing for personnel training, or for development testing of service equipment.

Constructed almost entirely of Fiberglas laminates, the RP-77D is powered by a Boeing Model 502-10 free-turbine turboprop engine.

Guidance is by remote radio control and autopilot with heading control. Optional equipment includes radar reflector wing-tip pods, fuselage radar reflectors, tail-cone radar reflector kit, radio-active detection and measuring kit, weather recording and/or transmitting kit, smoke system, scoring system, photographic equipment, night lights, positive identification aid for tracking etc.

The RP-77D is zero-length launched and is recoverable by a two-stage parachute.

DIMENSIONS.—
Span (over wing-tip pods) 15 ft. (4.57 m.).
Length 14 ft. 9 in. (4.49 m.).
Fuselage diameter 2 ft. (0.61 m.).

PERFORMANCE (estimated).
Max. speed 420 m.p.h. (672 km.h.).
Operational height S/L to 47,000 ft. (14,335 m.).
Endurance 1 hour at 40,000 ft. (12,200 m.).



The Radioplane RP-77D Target on its zero-length launcher.

RAWDON

RAWDON BROTHERS AIRCRAFT, INC.

HEAD OFFICE AND WORKS: P.O. Box 1119, WICHITA 1, KANSAS.

Manager: Gene Rawdon.

Rawdon Bros. Aircraft, Inc. has designed and built the T-1 two-seat monoplane, and is developing an advanced version of this aircraft with a 180 h.p. Lycoming engine, of which no details are yet available. It also manufactures aircraft spraying and dusting equipment, accessories, etc. and operates overhaul and maintenance shops.

THE RAWDON T-1.

The Rawdon T-1 is intended primarily as a two-seat trainer; but is suitable for touring, crop-spraying and other duties. With an 80 U.S. gallon (302 litre) streamlined external spray tank installed under its fuselage, cruising speed is reduced by only about 4 m.p.h. (6.4 km.h.).

TYPE.—Two-seat Training monoplane.

WINGS.—Low-wing semi-cantilever monoplane. Modified Göttingen 398 wing section. Chord 5 ft. 2 in. (1.57 m.). Dihedral 4° 30′. All-metal structure. Single steel-tube struts in plane of the main spar brace landing-gear attachment points to steel-tube pylon, between two seats. Steel-tube-framed ailerons and flaps are fabric covered. Gross wing area 166 sq. ft. (15.5 m.²).

FUSELAGE.—Welded steel-tube structure covered with fabric over wooden formers.

TAIL UNIT.—Braced monoplane type. Welded steel-tube frames covered with fabric. Statically-balanced rudder and elevators. Plywood-covered trim-tabs in both elevators. Span of tail 10 ft. 2 in. (3.09 m.).

LANDING GEAR.—Fixed tail-wheel type. Cantilever legs with Rawdon oleo-sprung shock-absorbers. Goodyear wheels and hydraulic disc brakes. Full swivelling and steerable tail-wheel on Maule oleo-spring strut. Track 9 ft. 11 in. (3 m.).

POWER PLANT.—One 150 h.p. Lycoming O-320 four-cylinder horizontally-opposed air-cooled engine. Sensenich fixed-pitch metal airscrew. Hartzell constant-speed airscrew optional. Two Goodyear Pliocel flexible fuel tanks in wing roots. Normal fuel capacity 38 U.S. gallons (144 litres), optional 44 U.S. gallons (166 litres).

ACCOMMODATION.—Tandem seats with dual controls under transparent canopy. Upper panels over seats hinge to right side for access and exit. Vertically sliding lower side panels. Baggage compartment aft of rear seat. Optional equipment includes an 80 U.S. gallon (302 litre) external spray tank for agricultural duties.

DIMENSIONS.—
Span 33 ft. 4 in. (10.16 m.).
Length 24 ft. 2 in. (7.52 m.).
Height 7 ft. 3 in. (2.21 m.).

WEIGHTS AND LOADINGS.—
Weight empty 1,300 lb. (590 kg.).
Weight loaded 1,900 lb. (863 kg.).
Wing loading 11.4 lb./sq. ft. (55.6 kg./m.^{2}).
Power loading 12.7 lb./h.p. (5.76 kg./h.p.).

PERFORMANCE (150 h.p. Lycoming O-320 engine and fixed-pitch airscrew).—
Max. speed 138 m.p.h. (221 km.h.).
Cruising speed (65% power) 120 m.p.h. (192 km.h.).
Landing speed (with flaps) 50 m.p.h. (80 km.h.).
Initial rate of climb 900 ft./min. (275 m./min.).
Service ceiling 18,000 ft. (5,490 m.).
Cruising range 500 miles (800 km.).



The Rawdon T-1SD (150 h.p. Lycoming O-320 engine).

Take-off to clear 50 ft. (15.25 m.) with 12° flap 600 ft. (183 m.).
Landing distance from 50 ft. (15.25 m.) with 30° flap 600 ft. (183 m.).

THE RAWDON T-1S.

This is a crop-spraying version of the T-1, with which it is identical except for the installation of a spray tank and equipment. The spray manifolds are entirely within the wings, only the nozzles projecting below the lower surface. The tank holds up to 800 lb. of spray material. All spray equipment, except the manifolds, is quickly removable.

THE RAWDON T-1SD.

A further development of the basic T-1 design, the new T-1SD agricultural aircraft has a large Fiberglas hopper in place of the normal rear cockpit enclosure and end plates on the wing-tips, but otherwise it is generally similar to the T-1, with the same 150 h.p. Lycoming O-320 engine. It can be used either for dusting with powder or spraying with liquids.

REPUBLIC

THE REPUBLIC AVIATION CORPORATION.

HEAD OFFICE AND WORKS: FARMINGDALE, LONG ISLAND, N.Y.
GUIDED MISSILES DIVISION: 233, JERICHO TURNPIKE, MINEOLA, LONG ISLAND, N.Y.
President: Mundy I. Peale.
Vice-President in charge of Research and Development: Alexander Kartveli.
Vice-President and General Manager: Walter G. Bain.
Vice-President and Assistant to the President: Ken Ellington.
Vice-President in charge of Industrial Relations: John J. Ryan.
Vice-President in charge of Sales: L. L. Brabham.
Vice-President: Martin F. Scanlon.
Vice-President in charge of Engineering Department and Guided Missiles Division: Alden R. Crawford.
Vice-Chairman and Director of European Operations: J. M. Starling.
Secretary: John A. Thompson.
Treasurer: Tom Davis.

Production facilities of the Republic Aviation Corporation are devoted largely to the production of military aircraft and missiles.

Production of the F-84 Series aircraft (Thunderjet, Thunderstreak and Thunderflash) ceased in August, 1957, with the delivery of the 7,883rd aircraft of the series, which included 4,457 Thunderjet fighter-bombers, 2,711 Thunderstreaks and 715 Thunderflash photographic reconnaissance fighters. In addition to widespread service with the U.S.A.F., F-84 Series aircraft have been supplied to France, Belgium, the Netherlands, Norway, Italy, Greece, Denmark, Portugal, Turkey, Yugoslavia, Thailand, West Germany and Nationalist China.

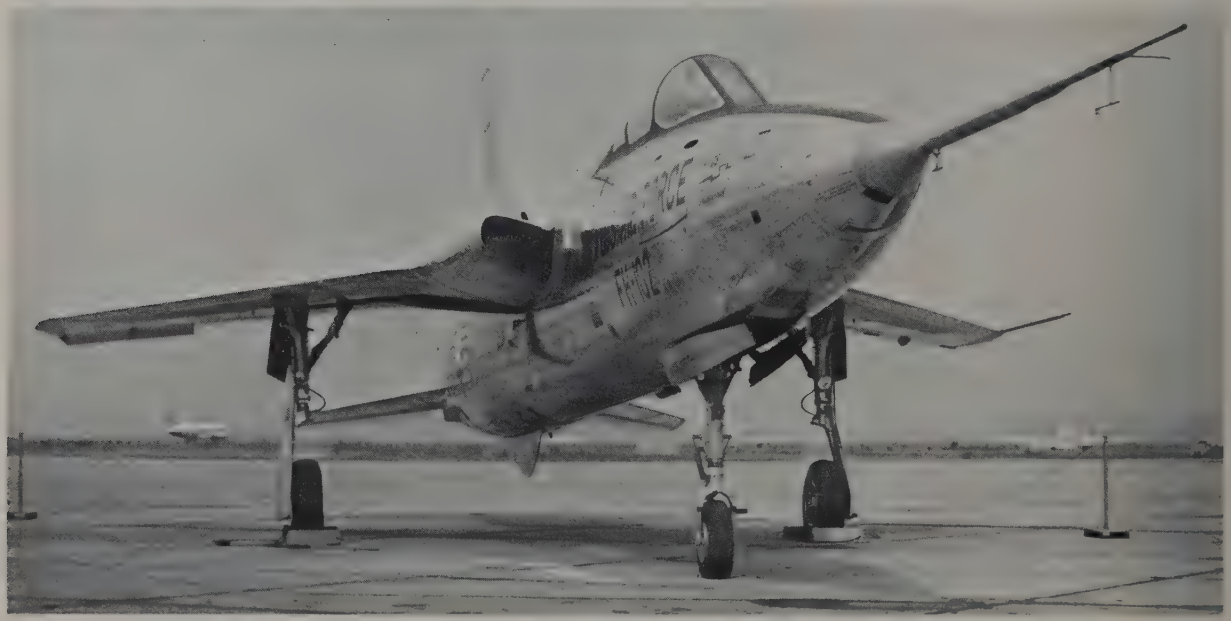
To supervise the assembly, maintenance, modification and repair of these aircraft in Europe, a company known as Republic Aviation International was formed in Lugano, Switzerland, in 1953 and this company now has contracts with 15 major European aircraft and equipment manufacturers in the United Kingdom, France, Germany, the Netherlands and Italy.

The new F-105B Thunderchief supersonic fighter-bomber was ordered into production in 1956, following very successful initial flight tests.

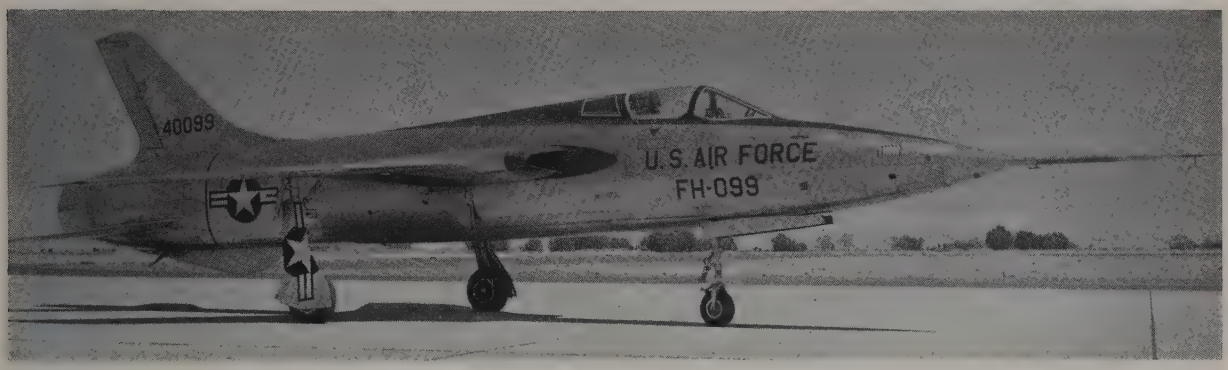
Republic has many other engineering projects in hand. In particular, its Guided Missiles Division is producing nose-cone structural units for an intercontinental ballistic missile under subcontract to General Electric Company; and is working on an air-to-surface fire control system for directing an airborne missile towards a target on sea or land.

In August, 1957, it was announced that the Guided Missiles Division had been awarded U.S. Army contracts for two new types of aerial drone aircraft suitable for all-weather battlefield reconnaissance. One will be an airscrew-driven type for immediate operational use; the other will be of more advanced design. Both drones will be zero-length launched and will be recoverable. The contracts cover design, development and production.

In addition, this Division has produced the two-stage Terrapin lightweight high-altitude research missile, which is described in the "Guided Missiles" section



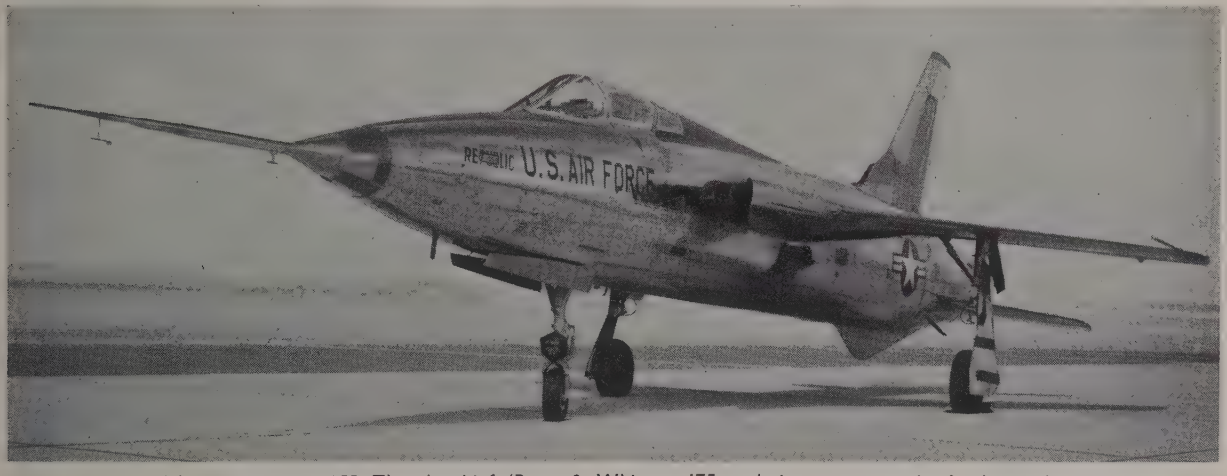
The Republic F-105B Thunderchief (Pratt & Whitney J75 turbojet engine and afterburner).



The Republic YF-105A with the original air intakes and vertical tail surfaces.

of this work, and is developing a third-stage rocket for the Terrapin which will enable it to climb to heights of 200 miles (320 km.) or more.

In December, 1957, Republic announced the formation of a Helicopter Division to handle the sales, assembly and the ultimate manufacture of the Alouette II turbine-powered helicopter under licence from Sud-Aviation of France. The licensing agreement provides for (*a*) the assembly, flight-testing, marketing and servicing of the Alouette II on the American continent by Republic, with the initial manufacture of all components and engines in France; and (*b*) the eventual production of the Alouette II by Republic in America after a phase of gradually entering into manufacturing by domestically producing an increasing number of Alouette components to be integrated with French production. Full details of the Alouette II will be found under "Sud" (France).



The Republic F-105B Thunderchief (Pratt & Whitney J75 turbojet engine with afterburner).

THE REPUBLIC F-105 THUNDERCHIEF.

The F-105 has been developed to meet U.S.A.F. requirements for a supersonic single-seat fighter-bomber able to deliver nuclear weapons as well as heavier loads of conventional bombs and rockets at very high speeds and over long ranges. It is classed as a "weapons system," because all integral components were designed as a unified whole to accomplish this specific mission.

The following versions have been announced :—

YF-105A. The prototype of this version exceeded Mach 1 during its initial test flight on October 22, 1955, powered by a Pratt & Whitney J57 turbojet engine. Six built.

F-105B. Pratt & Whitney J75-P-3 or -5 turbojet engine (15,000 lb. = 6,810 kg. s.t. dry) with afterburner. Single-seat day fighter-bomber. The first of this developed version was delivered to the U.S.A.F.'s Flight Test Center in the Spring of 1956 and the first production model was delivered to the U.S.A.F. Tactical Air Command on May 27, 1958. The F-105B was scheduled to reach volume production in the Autumn of 1958.

F-105D. Single-seat all-weather fighter-bomber version.

F-105E. Two-seat all-weather fighter-bomber.

TYPE.— Single-seat Supersonic Fighter-bomber.

WINGS.—Cantilever mid-wing monoplane. Very thin wing section. Highly-swept, with controllable conical cambered leading-edge and unique swept-forward air intake ducts in wing root leading-edges to provide double shock-wave to slow compressor air and to reduce turbulance in way of tail-plane. All-metal structure.

FUSELAGE. — All-metal semi-monocoque structure with "wasp-waist" in way of wings in accordance with Area Rule. Radar in nose. Large internal weapons bay under wing position. "Clover-leaf" speed brakes form last 3 ft. (0.91 m.) of fuselage around tail-pipe.

TAIL UNIT.—Cantilever monoplane type. All surfaces highly swept. Ram air intake in base of fin to provide cooling air for rear end of aircraft. One-piece "flying tail" set low on fuselage. Under-fuselage ventral stabilising fin. All-metal structure.

LANDING GEAR.—Retractable tricycle type. Main units retract inward into wings. Nose-wheel retracts forward into fuselage.

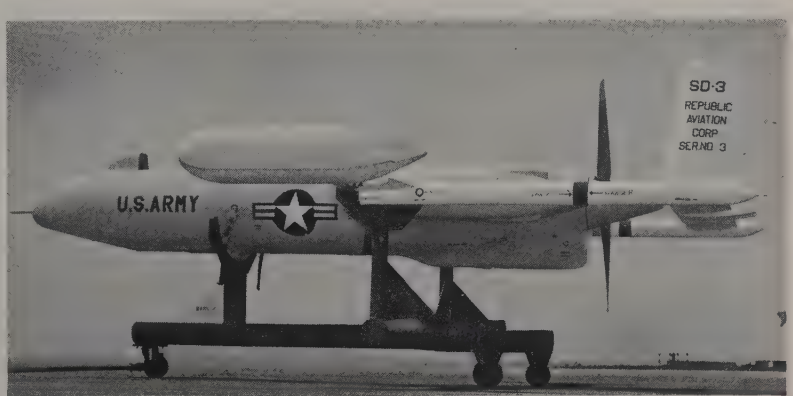
POWER PLANT.—One Pratt & Whitney J75 turbojet engine with afterburner. Provision for carrying five external fuel tanks and for flight refuelling at supersonic speeds and high altitudes.

ACCOMMODATION.—Pilot seated in pressurised cabin. High degree of automation in navigation and bombing systems. General Electric automatic flight-control system.

ARMAMENT.—Fixed armament comprises 20 mm. Vulcan multi-barrel gun. Nuclear weapons in internal bomb-bay, plus 4,000 lb. (1,800 kg.) of h.e. bombs, napalm tanks, clusters of unguided rockets or guided missiles under wings.

DIMENSIONS.—
Span 34 ft. 11 in. (10.64 m.).
Length 63 ft. 1 in. (19.23 m.).
Height 19 ft. 8 in. (6.00 m.).

WEIGHTS AND PERFORMANCE.—
No details available.



The Republic SD-3 All-weather Surveillance Drone.

THE REPUBLIC SD-3.

The SD-3 is a pilotless combat all-weather surveillance drone which is being produced in service test form for the U.S. Army by Republic's Guided Missiles Division.

The general arrangement of the propeller-driven SD-3 can be seen in the illustration on the previous page. It is designed to use various forms of advanced surveillance equipment, such as photography, radar and infra-red devices in interchangeable nose units which can be quickly changed in the field.

The SD-3 is zero-length launched using JATO, and is recoverable. All other details are restricted.

RIDDLE



The Riddle C-46R Transport (two 2,100 h.p. Pratt & Whitney R-2800 engines).

RIDDLE AIRLINES, INC.

HEAD OFFICE AND WORKS: MIAMI INTERNATIONAL AIRPORT, FLORIDA.

President: J. P. Riddle.

Vice-President, Engineering: N. H. Golden.

Riddle Airlines, who operate one of the world's largest commercial fleets of Curtiss C-46 transport aircraft, have produced a modification scheme which adds 40 m.p.h. to the cruising speed of the C-46 and enables it to carry an extra ton of payload. In addition, the modified aircraft meets the T-category requirements of the Civil Aeronautics Administration, which must be conformed to by all C-46 operators in the United States, and can be used for scheduled passenger services.

In addition to modifying their entire fleet of 32 C-46's, Riddle Airlines are offering to modify aircraft owned by other companies and have licensed Aeronavali of Venice, Italy, to carry out similar conversions for C-46 operators in Europe. Initially, Aeronavali have a contract to modify four aircraft for Westair Transport of Seattle.

THE RIDDLE C-46R.

The prototype Riddle C-46R conversion flew for the first time on March 10, 1956, followed by the first production conversion on August 14, 1957.

The C-46R is powered by two 2,100 h.p. Pratt & Whitney R-2800 engines, which enable it to carry a ton more payload than the standard C-46 and to climb with a full load with one engine inoperative. It provides maximum accommodation for 62 passengers or equivalent freight.

Three versions are available, as follows:

C-46R-1. With metal ailerons.

C-46R-5. With fabric-covered ailerons and hydraulic boost system.

C-46R-10. Basic C-46R-5 with outer wings converted to C-46R-1 standard, and with metal ailerons.

To reduce operating and maintenance costs, off-the shelf production items are used wherever possible. The new engines allow longer maintenance-free operation due to improved design. Ignition analyzer systems are installed. Fuel flow indicators and manual-leaning carburettors are used to reduce fuel consumption. An electrically-powered auxiliary hydraulic pump allows adjustments without use of external hydraulic sources.

New safety features include an Edison "continuous wire" fire detection system; a Kidde CF3BR extinguisher system; a stainless steel secondary firewall to isolate the power section, and fireproofed fuel and oil lines and all emergency wiring in fire zones. The baggage compartments are sealed for fire protection.

The instrument panel has been completely redesigned using suggestions from Riddle Airlines' pilots, and includes red night-lighting. New Janitrol cabin and cockpit heaters are installed, together with improved radio and radio-navigational equipment and new wheel and brake assemblies developed by B. F. Goodrich and Company.

DIMENSIONS.—
Span 108 ft. 1 in. (32.9 m.).
Length 76 ft. 4 in. (23.3 m.).
Height 21 ft. 9 in. (6.6 m.).

WEIGHT.—
Weight empty 29,300 lb. (13,290 kg.).
Max. payload 17,400 lb. (7,892 kg.).
Weight loaded 50,000 lb. (22,680 kg.).
Zero fuel weight 47,130 lb. (21,378 kg.).
Max. landing weight 48,000 lb. (21,770 kg.).

PERFORMANCE.—
Max. speed 270 m.p.h. (435 km.h.).
Max. cruising speed (1,000 h.p.) at 9,000 ft. (2,745 m.) 235 m.p.h. (378 km.h.).
Stalling speed 95 m.p.h. (153 km.h.).
Rate of climb at S/L. 1,140 ft./min. (350 m./min.).
Rate of climb at S/L one engine out, 317 ft./min. (96.5 m./min.).
Service ceiling 22,000 ft. (6,700 m.).
Service ceiling, one engine out 6,500 ft. (1,980 m.).
Take-off distance to 50 ft. (15.25 m.) 5,400 ft. (1,645 m.).
Landing distance from 50 ft. (15.25 m.) 3,600 ft. (1,100 m.).
Range in still air 1,800 miles (2,895 km.).

ROTOR-CRAFT

ROTOR-CRAFT CORPORATION.

HEAD OFFICE AND WORKS: 1850, VICTORY BOULEVARD, GLENDALE, CALIFORNIA.

President: Gilbert Magill.

The Rotor-Craft Corporation has designed and built, under U.S. Navy contracts, an ultra-lightweight one-man helicopter, brief details of which follow:—



The Rotor-Craft RH-1 Pinwheel Lightweight Helicopter.

THE ROTOR-CRAFT RH-1 PINWHEEL.

The Model RH-1 was designed to carry one fully-armed soldier and its structure has therefore been kept as simple as possible. The "backbone" of the vehicle consists of a reinforced curved steel tube which supports the two-blade rocket-driven rotor, the pilot's seat and a simple tubular tail-boom which carries the steering tail rotor. The main rotor is of all-metal construction, with folding blades, and is carried on a fully-articulated hub. It has a disc area of approximately 200 sq. ft. (18.58 m.²). The single-blade metal and wood tail rotor is driven by a belt passing over a pulley on the main rotor shaft and has a disc area of approximately 5 sq. ft. (0.46 m.²). A small fixed inverted Vee horizontal stabiliser is located aft of the tail rotor. The pilot's legs and feet serve as the landing gear. When not supported by the pilot, the helicopter rests on a retractable tripod parking stand. The diminutive Rotor-Craft R-1 rotor-tip rockets, which weigh less than one pound each, use liquid 90% hydrogen-peroxide as a mono-propellent and give over 20 lb. (9.1 kg.) s.t. each. The aircraft is capable of flying with only one of these units working.

An overhead type of cyclic control stick is used. The usual collective-pitch stick with twist-grip throttle handle is located at the pilot's left. Because the feet are used for landing there are no rudder pedals. Steering, by changing the pitch of the tail rotor, is accomplished by twisting the horizontal cyclic handle right or left.

The pilot occupies a pivotal seat and is secured in place by shoulder and waist straps. Instruments consist of a rotor tachometer, airspeed indicator and fuel quantity gauge, located on a panel above the handle on the cyclic control stick.

The helicopter can be folded up, dropped by parachute or stowed aboard a submarine and two can be carried inside a station wagon.

The Model RH-1 made its first free flight in April, 1954.

DIMENSIONS.—
Main rotor diameter approx. 16 ft. (4.88 m.).
Tail rotor diameter 2 ft. 4 in. (0.71 m.).
Overall length 8 ft. (2.44 m.).
Overall width 5 ft. (1.52 m.).
Height, pilot standing 8 ft. (2.44 m.).
WEIGHTS (approx.).—
Weight empty 165 lb. (75 kg.).
Weight loaded over 400 lb. (181 kg.).
PERFORMANCE.—
Cruising speed 60-70 m.p.h. (96-112 km.h.).

THE ROTOR-CRAFT SKY HOOK.

Now under development, the Sky Hook will be so small that it will fit into an "oversize suitcase" and will weigh less than 75 lb. (34 kg). It has been designed for assembly without tools in less than two minutes. No other details are yet available.

RYAN

THE RYAN AERONAUTICAL COMPANY.

HEAD OFFICE AND WORKS: LINDBERGH FIELD, SAN DIEGO 12, CALIFORNIA.

President: T. Claude Ryan.

Executive Vice-President: G. C. Woodard.

Vice-President and Chief Engineer: Frank W. Fink.

Vice-President Engineering: Bruce Smith.

Secretary and Treasurer: C. A. Stillwagen.

Sales Manager: Clark Hickerson.

The Ryan Aeronautical Company is a successor to the old Ryan Company which produced the aeroplane in which Mr. Charles Lindbergh made the first non-stop flight from New York to Paris in 1927.

The current activities of the Ryan Aeronautical Company are diversified and fall into four main groups:—(*a*) research and development in and the manufacture of aircraft and aeronautical products of the company's own design; (*b*) production of airframe components for other manufacturers; (*c*) the production of high-temperature parts for aircraft engines; and (*d*) electronics systems.

Important aeronautical research programmes, including development of two types of vertical take-off aircraft and production of the Ryan Firebee pilotless jet-powered target aircraft, are being conducted for the U.S. Air Force, Army and Navy. Prime contracts are held for the development of guidance systems for missiles and other electronic devices of Ryan design.

Among airframe components of Ryan design being manufactured in volume are aft fuselage sections, each 60 ft. (18.3 m.) long, for Boeing KC-135 jet tanker-transports and complete engine pods and pylons for the Douglas DC-8 jet transport.

For aircraft engines Ryan builds heat and corrosion-resistant stainless-steel components, and applies ceramic coatings for jet engines, piston engines and rocket motors. Products include such items as exhaust cones, tail pipes, combustion chambers, afterburners and exhaust nozzles for jet engines, exhaust systems for aircraft piston engines, and complete rocket motors for guided missiles.

THE RYAN MODEL 92 VERTIPLANE. U.S. Army designation: VZ-3RY.

In June, 1956, Ryan announced that it had received a contract to build a vertical take-off aircraft for the U.S. Army under the technical direction of the Office of Naval Research. Known as the Vertiplane, this aircraft is a simply-constructed two-seat research monoplane of fairly conventional high-wing configuration but with very extensive double retractable wing flaps which extend far below and to the rear of the wing trailing edge.

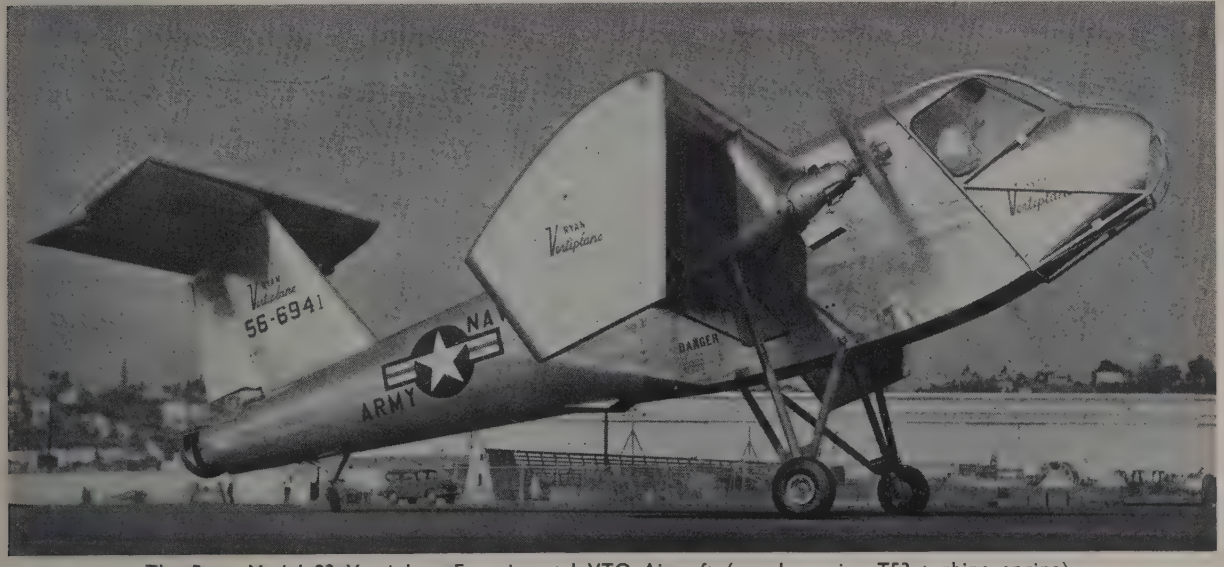
The Vertiplane is powered by a single 1,000 s.h.p. Lycoming T53-L-1 shaft-turbine engine, mounted in its fuselage and driving two wing-mounted Hartzell three-blade wooden airscrews of large diameter. The deflected slipstream from these, over the extended flaps, is expected to enable the aircraft to take off and land vertically and to hover. Large end-plates at the wing-tips provide structural support for the flaps and confine the slipstream to the flap span for maximum efficiency.

Conventional stick and rudder pedal controls are fitted in the cockpit to operate the rudder, elevator, variable-incidence tailplane and the spoilers which are inset in the upper surface of each wing ahead of the flaps and which take the place of the usual ailerons. A universally-jointed jet-deflection nozzle at the rear of the tailpipe from the engine helps to ensure adequate control during hovering flight.

The prototype Vertiplane began its taxying trials on February 7, 1958, and at the time of writing was undergoing extensive tethered testing in a ground rig. Vertical take-offs and landings were expected to follow, with the first translational flights scheduled for late 1958.

For transition into horizontal flight, the flaps will be retracted as the aircraft picks up speed, and it will cruise as a conventional high-wing monoplane. When landing, the pilot will make his approach with power on and some flap deflection. He will then extend the flaps progressively and increase power until the Vertiplane "parachutes" in to touch down at zero forward speed.

Developed versions of the Vertiplane are intended to meet U.S. Army requirements for a medium-speed liaison, reconnaissance and utility aircraft able to operate from rough terrain without any form of prepared landing site. They are also expected to be suitable for Naval



The Ryan Model 92 Vertiplane Experimental VTO Aircraft (one Lycoming T53 turbine engine).

anti-submarine duties and for commercial operation as executive and feeder-line transports.

DIMENSIONS.—
Span 23 ft. 5 in. (7.14 m.).
Length 27 ft. 8 in. (8.43 m.).
Height 10 ft. 8 in. (3.25 m.).

WEIGHT.—
Weight loaded approx. 2,600 lb. (1,180 kg.).

THE RYAN VERTIJET.
U.S.A.F. designation: X-13.

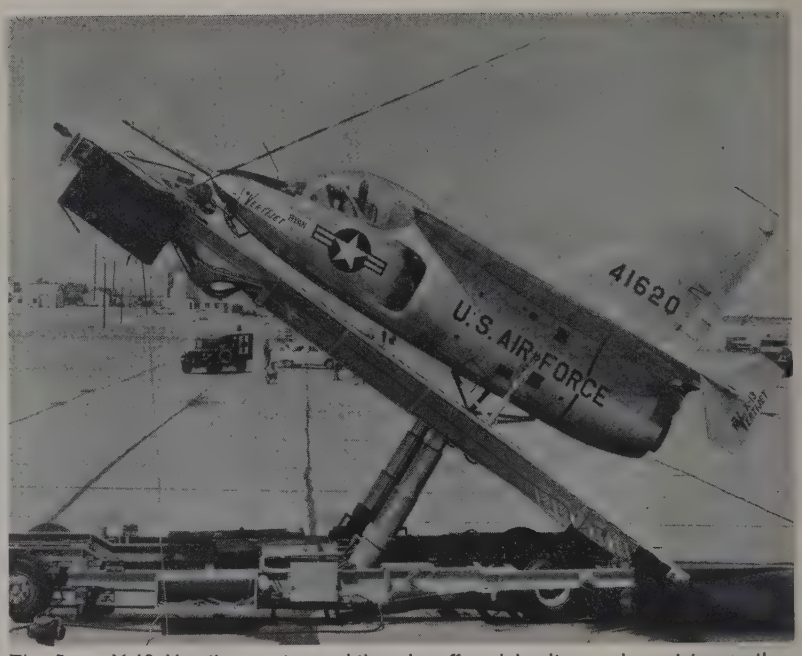
The Ryan X-13 Vertijet is a small single-seat "tail-sitting" V.T.O. research aircraft, powered by a single Rolls-Royce Avon turbojet engine (10,000 lb. = 4,535 kg. s.t.). Of all-metal construction, it has a high-set delta wing with small fins at the tips and a large vertical fin and rudder. It has no landing gear, taking off instead from a mobile ground servicing trailer, the bed of which is raised hydraulically to a vertical position so that the aircraft is suspended in a nose-up attitude by a hook under its forward fuselage which engages with a trapeze-structure on the trailer-bed.

Ryan began research into the possibilities of such an aircraft in 1947, by mounting an Allison J33 engine on a horizontal test stand and investigating methods of varying jet thrust for directional control. Next, the J33 was mounted in a vertical test rig, and finally was fitted with a cockpit, controls and delta wings for piloted tethered tests.

As a result of this successful programme, Ryan received a U.S.A.F. contract to build the X-13 in 1953, and the first prototype flew on December 10, 1955, fitted with a temporary fixed tricycle landing gear to permit normal horizontal take-off and landing. This landing gear was subsequently removed and replaced by a temporary tubular structure to allow the aircraft to be tested in the "tail-sitting" attitude. The first such flight was made on May 28, 1956, followed by simulated hook-ons to a nylon rope stretched between two upright steel towers.

A second prototype, also fitted with temporary tricycle landing gear, made the first transition from horizontal flight to hovering vertical flight and back to horizontal flight on November 28, 1956.

In its fully-developed form, the X-13 unhooks itself from the trailer under the direct jet thrust of its turbojet, and can be hovered and manoeuvred close to the ground. During take-off, landing and hovering flight, it is controlled by deflection of its jet exhaust and thrust (throttle) variations. Conventional control surfaces are provided for horizontal flight, both systems being operated by normal stick and rudder pedal cockpit controls. The pilot's seat is pivoted, so that he can sit partly-upright while the aircraft is standing on its tail.



The Ryan X-13 Vertijet on its mobile take-off and landing and servicing trailer.

The first complete flight sequence of vertical take-off, transition to horizontal cruising flight and return to vertical landing was accomplished on April 11, 1957. Subsequently tests have shown that vertical take-offs and landings can be made irrespective of wind direction.

DIMENSIONS (approx.).—
Span 21 ft. (6.40 m.).
Length 24 ft. (7.32 m.).
Height 15 ft. (4.57 m.).

WEIGHT.—
Weight loaded approx. 7,500 lb. (3,405 kg.).
Thrust/weight ratio: 1.3 : 1

PERFORMANCE.—
No details available.

THE RYAN FIREBEE.
U.S. Air Force designation: Q-2.
U.S. Army designation: XM21.
U.S. Navy designations: KDA-1 and -4.

The Firebee is a pilotless remotely-controlled high-speed turbojet-powered target drone which has been developed under a joint Air Force/Army/Navy project, with the U.S.A.F. Air Research and Development Command having technical cognizance of its development.

Glide flight tests of the Firebee without power were begun in March, 1951, and the first powered flights were made that Summer at the U.S.A.F. Holloman Air Development Center, Alamogordo, New Mexico. In the subsequent test programme the Firebee was launched from under the wings and from the bomb-bay of a Douglas B-26 carrier.

The following versions have been produced:—

XM21. First production version, ordered by the U.S. Army early in 1953 and now in operation at the Army Ordnance Proving Ground at White Sands, N.M., and at Fort Bliss, Texas, where they are used in training Army troops in the operation of the "Skysweeper" gun and for use as a target for the Nike ground-to-air guided missile. They are ground-launched from a zero-length launcher with the aid of a booster rocket, which is jettisoned after the target's jet engine has taken over.

KDA-1 and -4. For U.S. Navy. Original order announced in Spring of 1944. This version can be ramp or air-launched and has flotation gear for recovery at sea. It is being used for target practice at U.S. Naval bases on the east and west coasts of the United States, and in connection with the evaluation of guided missiles at the Naval Air Missile Test Center, Point Mugu, Cal., and the Naval Ordnance Test Station, Inyokern, China Lake, Cal. Thirty due for delivery during 1958 to the R.C.A.F. will be air-launched from modified Lancaster Mk. 10 aircraft operated by the Central Experimental and Proving Establishment.

Q-2A. Standard Firebee for U.S.A.F., to support missile development at Holloman Air Development Center, Alamogordo, N.M., and White Sands; for air-to-air rocket firing practice at Vincent Air Force Base, Yuma, Arizona; and at the Air Proving Ground Command's Eglin Air Force Base, Florida.

XQ-2B. Developed version for U.S.A.F. with air-to-air radio control, smoke-laying equipment, greater wing area, improved control system and other changes. An XQ-2B, with Continental J69-T-19A turbojet engine, achieved a height of 53,500 ft. (16,300 m.) during a test flight from Holloman A.D.C. After 97 minutes of powered flight it was saved by the standard parachute recovery technique. In this, a two-stage parachute system decelerates the target from its near-sonic operating speed and lowers it safely to the ground without damage to the structure or its delicate electronic controls.

The recovery system is also capable of


The Ryan KDA-1 Firebee under the starboard wing of a JD-1 carrier.

lowering the drone to the ground automatically in the event of a target hit, loss of radio wave carrier from the remote-control station, engine failure, or upon command by the remote control operator. To prevent damage by dragging, the recovery system incorporates a disconnect system which releases the parachute from the drone upon contact with the ground.

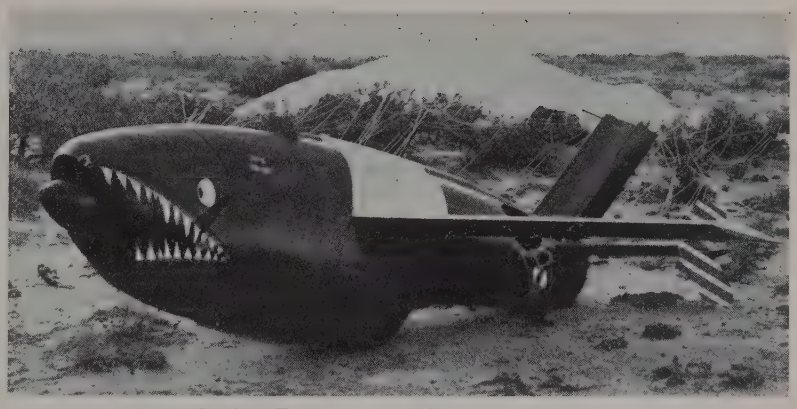
The Firebee is composed of five major assemblies—fuselage, engine nacelle, wing, tail-unit and parachute container. Construction is of aluminium, magnesium and stainless-steel. The wing and tail-unit are attached to the fuselage by four self-aligning bolts. The engine nacelle is hinged to give ready access to the interior of the compartment.

Remote control methods for the Firebee include a choice of radar, radio, active seeker and automatic navigator, all developed and designed by Ryan. Reflectors which are sensitive to radar have been incorporated to give gun crews an image on their radar scopes similar to that of a full-sized aircraft.

The following specification is based on the U.S.A.F. Q-2A version but applies in general to all models except the new XQ-2B.

TYPE.—Remote-controlled Jet Target Drone.

WINGS.—Mid-wing swept type. Aerofoil section NACA 63, A014.6. Aspect ratio 4.62. All-metal one-piece structure attached to fuselage by four bolts. Area of ailerons 2.08 sq. ft. (0.193 m.²) aft of hinge-line. Gross wing area 27.0 sq. ft. (2.508 m.²).



A Ryan Firebee Target Drone after landing by parachute.

FUSELAGE.—All-metal structure in one complete assembly.

TAIL UNIT.—Single assembly attached to fuselage by four bolts. All surfaces swept. Areas: fin 6.07 sq. ft. (0.564 m.²), vertical end plates 5.21 sq. ft. (0.484 m.²), tailplane 8.94 sq. ft. (0.830 m.²) elevators (aft of hinge-line) 3.36 sq. ft. (0.312 m.²).

POWER PLANT.—One Fairchild J44-R-20 or Continental (Turbomeca licence) J69-T-19 turbojet engine (1,000 lb.=454 kg. s.t. each). Fuel capacity 100 U.S. gallons (378 litres). Oil capacity 1 U.S. gallon (3.78 litres).

DIMENSIONS.—
Span 11 ft. 2 in. (3.40 m.).
Length 17 ft. 3 in. (5.26 m.).
Height 5 ft. 10 in. (1.79 m.).

WEIGHTS.—
Weight empty 1,181.4 lb. (536 kg.).
Weight loaded 1,848.6 lb. (839 kg.).

PERFORMANCE.—
Max. speed at S/L. 610 m.p.h. (976 km.h.).
Max. speed at 40,000 ft. (12,200 m.) 605 m.p.h. (968 km.h.).
Rate of climb at S/L. 8,500 ft./min. (2,590 m./min.).
Time to climb from launch altitude to 40,000 ft. (12,200 m.) 8 min.
Stalling speed 162 m.p.h. (259 km.h.).
Service ceiling 42,500 ft. (12,960 m.).
Endurance at 40,000 ft. (12,200 m.) at 575 m.p.h. (920 km.h.) 1 hr. 20 min.

SALVAY-STARK

SALVAY-STARK AIRCRAFT COMPANY.

HEAD OFFICE: 8296, POPPY WAY, BUENA PARK, CALIFORNIA.

This company has been formed by two engineers of the North American Aviation Company to market plans of a single-seat light aeroplane named the Skyhopper which they have designed and built.

A two-seat version of the Skyhopper is under development.

THE SALVAY-STARK SKYHOPPER.

Design of the Skyhopper was begun in the early spring of 1944 and the prototype flew for the first time 13 months later, towards the end of March, 1945. It was designed to comply with the CAR-04 requirements of the time and has since undergone considerable development and refinement. In particular, the original open cockpit has now given way to an enclosed cabin with sliding clear-view canopy.

Following nearly 1,000 hours of flying with the prototype, Salvay-Stark marketed plans of the Skyhopper in the Summer of 1958.

TYPE.—Single-seat light monoplane.

WINGS.—Cantilever low-wing monoplane. All-wood two-spar structure. Leading-edge covered with aluminium sheet; remainder fabric-covered. Statically and dynamically balanced ailerons, fabric-covered. No flaps. Wing area 100 sq. ft. (9.29 m.²).

FUSELAGE.—Welded steel-tube structure with fabric-covering.

TAIL UNIT.—Cantilever monoplane type. Tailplane and fin have plywood-covered wooden structure. Statically and dynamically balanced rudder and elevators have welded tube structure, with fabric covering.

LANDING GEAR.—Non-retractable tail-wheel type. Oil and spring shock-absorbers. Wheel spats.

POWER PLANT.—One 65 h.p. Continental A65 four-cylinder horizontally-opposed air-cooled engine driving two-blade fixed-pitch airscrew. Fuel capacity 15 U.S. gallons (56.8 litres).

ACCOMMODATION.—Single seat under rearward-sliding canopy. Small baggage space aft of seat.

DIMENSIONS.—
Span 25 ft. 0 in. (7.62 m.).
Length 18 ft. 7 in. (5.66 m.).
Height 5 ft. 3 in. (1.60 m.).

WEIGHTS.—
Weight empty 650 lb. (295 kg.).
Weight loaded 950 lb. (430 kg.).

PERFORMANCE.—
Max. speed 130 m.p.h. (209 km.h.).
Cruising speed 120 m.p.h. (193 km.h.).
Landing speed 42 m.p.h. (67.5 km.h.).
Range 400 miles (645 km.).



The Salvay-Stark Skyhopper (65 h.p. Continental A65 engine).

SCHWEIZER

SCHWEIZER AIRCRAFT CORPORATION.

HEAD OFFICE AND WORKS: COUNTY AIRPORT, ELMIRA, N.Y.

President and Chief Engineer: Ernest Schweizer.

Vice-President and General Manager: Paul A. Schweizer.

Vice-President in charge of Manufacturing: William Schweizer.

Director, Personnel and Public Relations: Eugene S. Bardwell.

Treasurer: Nicholas Haich.

Secretary: Robert P. McDowell.

The Schweizer Aircraft Corpn. specialises in the design and construction of gliders and sailplanes. It also manufactures parts and assemblies for other aircraft companies under sub-contract. The company furthermore maintains a complete aircraft and glider overhaul and repair service.

Schweizer is currently engaged in producing three gliders, the SGU 2-22-C two-seat training glider, the SGS 1-23D single-seat high-performance sailplane and the SGS 1-26 single-seat high-performance sailplane which is available both complete and in kit form for the home-builder.

By agreement with the Grumman Aircraft Engineering Corpn., Schweizer will build the Grumman agricultural biplane, a description of which will be found under "Grumman."

THE SCHWEIZER SGU 2-22-C SAILPLANE.

This two-seat sailplane, a modification of the SGU 2-22 which first flew in 1947, has been put into production to meet training requirements. Three have been supplied to the U.S. Air Force Academy.

TYPE.—Two-seat Utility Training Sailplane.

WINGS.—Strut-braced high-wing monoplane. Aspect ratio 8.81. Aluminium-alloy structure, with metal leading-edge and fabric covering aft. Total area of ailerons 19.46 sq. ft. (1.81 m.²). Wing area 210 sq. ft. (19.51 m.²).

FUSELAGE.—Welded steel-tube structure with fabric covering.

TAIL UNIT.—Braced monoplane type. Fin and rudder of aluminium construction with fabric covering. Strut-braced tailplane

and elevators of steel-tube construction with fabric covering.

LANDING GEAR.—Single wheel with Goodyear brake mounted on fuselage centre-line immediately aft of a single skid mounted on rubber blocks. Goodyear 6.00 × 6 wheel and tyre.

ACCOMMODATION.—Tandem seating for two persons under transparent canopy. Dual controls.

DIMENSIONS.—
Span 43 ft. (13.1 m.).
Length 25 ft. 0½ in. (7.63 m.).
Height 9 ft. (2.7 m.).

WEIGHTS.—
Weight empty 450 lb. (240 kg.).
Weight loaded 900 lb. (408 kg.).

PERFORMANCE.—
Max. level speed 89 m.p.h. (143 km.h.).
Stalling speed (solo) 28 m.p.h. (45 km.h.).
(dual) 31 m.p.h. (50 km.h.).
Gliding ratio 18 : 1.
Sinking speed (solo) 2.8 ft./sec. (.85 m./sec.)
(dual) 3 ft./sec. (.91 m./sec.).



The Schweizer SGU 2-22 Two-seat Utility Sailplane.

THE SCHWEIZER SGS 1-23D SAILPLANE.

The SGS 1-23D is the latest development of the 1-23 from which it differs mainly by having wings of higher aspect ratio for increased performance.

The earlier SGS 1-23 was first flown at the 1948 National Soaring Contest at Elmira, N.Y. On December 30, 1950, William Ivans in a 1-23 set a new World's Height Record when he soared to an absolute altitude of 42,100 ft. (12,832 m.) above sea level at Bishop, California. He gained 30,100 ft. (9,180 m.) above his release from aeroplane tow.



The Schweizer SGS 1-23D Single-seat Sailplane.

Production of the 1-23D was started in July, 1953. The description below refers to this model.

TYPE.—Single-seat High-performance Sailplane.

WINGS.—Mid-wing cantilever monoplane. Aspect ratio 15.58. All-metal structure. Aileron area (total) 19.40 sq. ft. (1.80 m.²). Spoiler area (total) 5.00 sq. ft. (0.464 m.²) Gross wing area 160 sq. ft. (14.87 m.²).

FUSELAGE.—Semi-monocoque structure of aluminium-alloy.

TAIL UNIT.—Cantilever monoplane type. All-metal structure including covering. Tailplane span 7 ft. (2.13 m.). Horizontal tail surface area 15.13 sq. ft. (1.405 m.²). Vertical tail surface area 10.61 sq. ft. (0.98 m.²).

LANDING GEAR.—Single unsprung wheel with Schweizer brake on fuselage centre-line, with single skid on solid rubber blocks ahead of wheel. Rubber-mounted tail-skid.

ACCOMMODATION. — Pilot's cockpit with moulded Plexiglas canopy. Fully equipped instrument panel. Room behind pilot for radio, barograph and oxygen equipment.

DIMENSIONS.—
Span 50 ft. (15.25 m.).
Length 20 ft. 9 in. (6.33 m.).
Height 6 ft. 10 in. (2.08 m.).

WEIGHTS AND LOADINGS.—
Weight empty 400 lb. (181.4 kg.).
Pilot 190 lb. (86 kg.).
Extra equipment 160 lb. (72.6 kg.).
Max. permissible loaded weight 750 lb. (340 kg.).
Wing loading 4.69 lb./sq. ft. (22.66 kg./m.²).

PERFORMANCE.—
Designed max. speed 132 m.p.h. (211 km.h.).
Cruising speed 85 m.p.h. (136 km.h.).
Min. sinking speed 2.0 ft./sec. (0.6 m./sec.).
Max. glide ratio 30 : 1.
Glide or Dive Placard speed 119 m.p.h. (190 km.h.).
Aeroplane towing speed 110 m.p.h. (176 km.h.).
Auto towing speed 68 m.p.h. (109 km.h.).

THE SCHWEIZER SGS 1-26 SAILPLANE.

Externally similar to the earlier SGS 1-23D, the SGS 1-26 first flew in January, 1954, and production was under way in November, 1954. Whereas the earlier SGS 1-23D is entirely of metal construction, the SGS 1-26, which is available in kit form, has fabric-covered outer wing panels, control surfaces, fuselage and tail-unit. Further to assist the amateur constructor, all the complicated alignments, welding and assemblies requiring specialised tooling are undertaken by the manufacturer, including a pre-formed aluminium nose-cap and Plexiglas canopy. The design has been granted an Approved Certificate (No. TC1G10). From 300 to 600-man-hours are required for assembly depending on the experience and skill of the builder. The latest 1-26B version, supplied to the U.S. Air Force Academy, has oxygen equipment and two-way radio.

TYPE.—Single-seat High-performance Sailplane.

WINGS.—Mid-wing cantilever monoplane. Aspect ratio 10. Dihedral 3½°. All-metal structure of aluminium alloy. Strengthened metal-covered pre-formed leading-edge. Fabric-covered rear sections of outer wing panels. Spoiler area (two) total 2.78 sq. ft. (0.26 m.²). Wing area 160 sq. ft. (14.87 m.²).

FUSELAGE.—Welded chrome-molybdenum steel tube framework covered with fabric.

TAIL UNIT.—Cantilever monoplane type. Aluminium-alloy structure covered with fabric. Tailplane span 7 ft. 6 in. (2.29 m.).

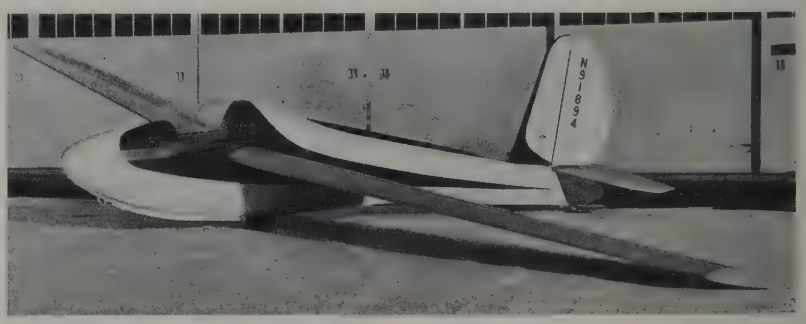
LANDING GEAR.—Single unsprung wheel (4.00-4 with Schweizer brake) on the fuselage centre-line with single skid on solid rubber blocks ahead of wheel. Rubber-mounted tail-skid.

ACCOMMODATION.—Single seat beneath moulded Plexiglas canopy. Provision for radio behind pilot.

DIMENSIONS.—
Span 40 ft. (12.19 m.).
Length 21 ft. 3 in. (6.48 m.).
Height 7 ft. 2½ in. (2.21 m.).

WEIGHTS AND LOADINGS.—
Weight empty 350 lb. (158.76 kg.).
Pilot 190 lb. (86 kg.).
Extra equipment 35 lb. (15.88 kg.).
Max. (gross) weight 575 lb. (260.6 kg.).
Wing loading (normal) 3.13 lb./sq. ft. (15.15 kg./m.²).
Wing loading (max.) 3.54 lb./sq. ft. (17.29 kg./m.²).

PERFORMANCE.—
Min. sinking speed less than 2.5 ft./sec.
Max. glide ratio more than 23 : 1.



The Schweizer SGS 1-26 Sailplane which is marketed in kit form.

SIKORSKY

SIKORSKY AIRCRAFT DIVISION OF UNITED AIRCRAFT CORPORATION.

HEAD OFFICE AND WORKS: STRATFORD, CONNECTICUT.

OTHER WORKS: SOUTH AVENUE, BRIDGEPORT, CONNECTICUT.

General Manager: L. S. Johnson.

Assistant General Manager: L. P. Doty.

Engineering Manager: Michael E. Gluhareff.

Factory Superintendent: Alex Sperber.

Divisional Controller: Paul W. Holt.

Divisional Auditor: G. L. Wadman.

Sikorsky's main plant at Stratford, which has 800,000 sq. ft. of working space, is devoted primarily to production of the S-56 (HR2S and H-37) twin-engined helicopter and the S-55 series of single-engined helicopters. Production of the single-engined S-58 series continues in the company's original 600,000 sq. ft. plant at Bridgeport.



The Sikorsky S-62 General Purpose Helicopter (1,050 s.h.p. General Electric T58 shaft-turbine).

Projects currently in hand include the S-60 flying crane ; the S-61 twin-turbine amphibious helicopter for the U.S. Navy ; and the turbine-powered S-62, which utilises many components of the S-55 and is described in detail hereafter.

THE SIKORSKY S-62.

The S-62 uses many well-proven components of the S-55, including all rotor blades ; main and tail rotor heads ; main, intermediate and tail gearboxes ; shafting ; tail rotor pylon ; and portions of the flying control and hydraulic systems. Its empty weight is, however, some 700 lb. (318 kg.) less than that of the S-55, largely because it is powered by a 1,050 s.h.p. General Electric T58-GE-6 shaft-turbine, instead of by the latter's heavier piston-engine. As it also has 230 more horsepower available for high-altitude or hot weather flight, it can carry a payload approximately 700 lb. (318 kg.) greater than that of the S-55 under all conditions. Full power is available at heights up to 17,000 ft. (5,180 m.).

The S-62 has been designed from the start for amphibious operation, so that flotation gear is not required for over-water flights. The bottom of the fuselage is watertight and strengthened to permit landings on either water or snow ; and there are two outrigger floats, mounted forward and well away from the fuselage, to resist pitching or rolling during touchdown or while at rest on the water. The main wheels of the tail-wheel type landing gear are carried under these floats and can be partially-retracted in flight.

The cabin accommodates 8-12 passengers and is 14 ft. long, 5 ft. 4 in. wide and 6 ft. deep (4.27×1.62×1.83 m.). Fuel capacity is 182 U.S. gallons (690 litres).

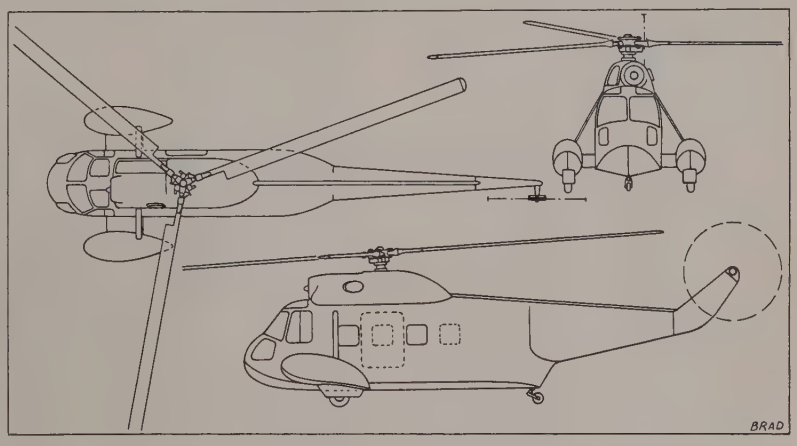
The first S-62 flew for the first time in May, 1958.

Optional equipment includes a 600 lb. (270 kg.) capacity rescue hoist, an external cargo sling capable of carrying 3,000 lb. (1,360 kg.), internal ferry tanks, and a towing attachment to provide 4,000 lb. (1,815 kg.) of traction for such work as removing damaged aircraft from runways.

DIMENSIONS.—
Main rotor diameter 53 ft. (16.16 m.).
Tail rotor diameter 8 ft. 9 in. (2.67 m.).
Fuselage length 44 ft. 7 in. (13.59 m.).
Height overall 14 ft. 2 in. (4.32 m.).
Wheel track 11 ft. (3.35 m.).

WEIGHTS.—
Weight empty 4,409 lb. (2,000 kg.).
Pilot 200 lb. (91 kg.).
Fuel and oil 633 lb. (287 kg.).
Equipment 418 lb. (190 kg.).
Payload 1,840 lb. (835 kg.).
Weight loaded 7,500 lb. (3,403 kg.).

PERFORMANCE (estimated at 7,500 lb. = 3,403 kg. A.U.W.).—
Max. speed at S/L 120 m.p.h. (193 km.h.).
Cruising speed at 1,000 ft. (305 m.) 92 m.p.h. (148 km.h.).
Vertical rate of climb at S/L 450 ft./min. (137 m./min.).
Max. rate of climb at S/L 1,160 ft./min. (355 m./min.).
Hovering ceiling out of ground effect 7,800 ft. (2,375 m.).
Service ceiling 15,700 ft. (4,785 m.).



The Sikorsky S-62 Helicopter.

THE SIKORSKY S-61.

U.S. Navy designation: HSS-2.
U.S. Marine Corps designation: HUS-2.

The S-61 is an amphibious helicopter with a flying-boat hull and powered by two General Electric T58-GE-6 shaft-turbines mounted side-by-side above its cabin. Larger than the single-engined commercial S-62, it is intended for use by the U.S. Navy for anti-submarine duties and by the U.S. Marine Corps as a troop carrier. It will have all-weather flying capabilities and will be capable of lifting an external load of 6,000 lb. (2,720 kg.).

Under construction in 1958, the S-61 is similar in general appearance to the S-62 and is scheduled to fly for the first time in 1959.

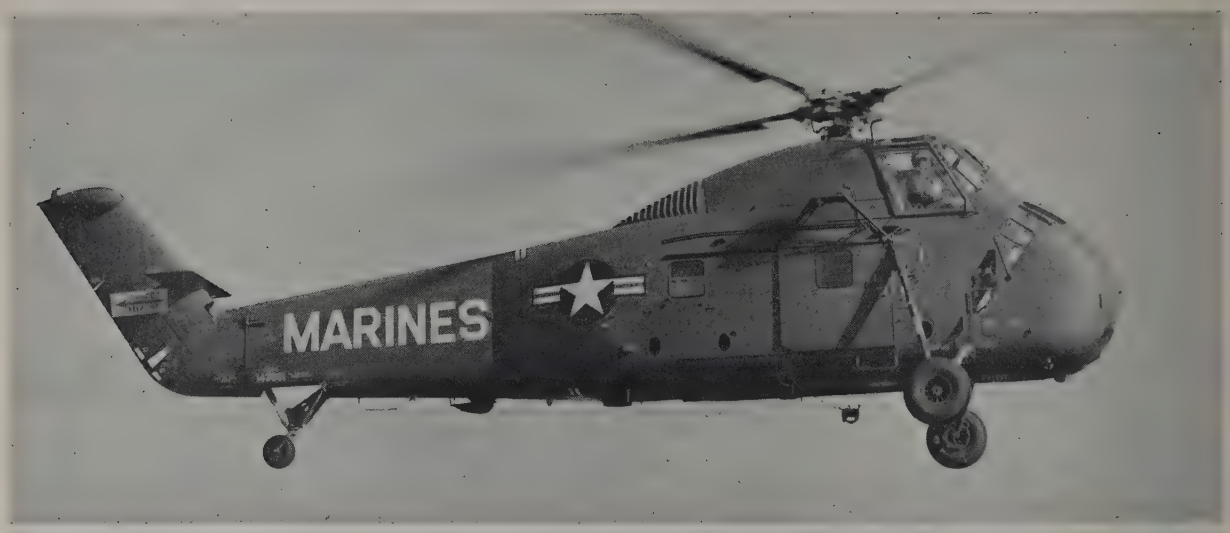
THE SIKORSKY S-58.

U.S. Navy designation: HSS.
U.S. Army designation: H-34 Choctaw.
U.S. Marine Corps designation: HUS-1.

The first prototype of this helicopter, which is larger than the S-55, flew on March 8, 1954, and the first production machine on September 20, 1954. The Army and Navy versions are generally similar, differing mainly in equipment and fuel capacity. There are two commercial versions of the S-58, of which the S-58B non-scheduled passenger-freighter is similar to the H-34. The S-58C scheduled passenger-carrying version has two entrance doors on the starboard side of the cabin. First commercial deliveries of the S-58C to Sabena (8) and New York Airways (3) were made in 1956-57.

A number of additions and improvements in the basic Naval HSS helicopter have led to the HSS-1N, which utilises Sikorsky's automatic stabilisation equipment and is suitable for day and night instrument flying. The changes include (1) incorporation of new radars to measure ground speed and altitude accurately ; (2) improved flight instrument and cockpit arrangement ; (3) addition of automatic engine r.p.m. controls ; and (4) introduction of an automatic "hover coupler". With the coupler, which uses the radar to determine ground motion, it is possible for the pilot to place the helicopter on automatic control at 200 ft. (60 m.) altitude and 92 m.p.h. (148 km.h.) airspeed and automatically to come to a zero ground speed hover at a 50 ft. (15 m.) altitude over a pre-selected spot.

A naval HSS helicopter has been fitted experimentally with two General Electric T58 shaft turbine engines instead of its normal R-1820 piston engine, in a slightly modified nose cowling. This aircraft made its first flight on January 30, 1957. Although weighing only a total of 650 lb. (295 kg.), compared with 1,400 lb.



The Sikorsky HUS-1 General Purpose Helicopter (1,525 h.p. Wright R-1820 engine).

(635 kg). for the piston engine, the turbines give an increase of more than 400 h.p.

TYPE.—General Purpose Helicopter.

ROTORS.—Four-blade all-metal main and tail rotors. Blades of main rotor interchangeable. Tail rotor has servo control. Main and tail rotor brakes. Main rotor disc area 2,460 sq. ft. (228.54 m.²).

TRANSMISSION.—Simplified transmission system has 25% fewer parts than in previous Sikorsky designs, and provides accessory drives for the generator and its blower, the cargo hoist, primary servo control hydraulic pump, rotor tachometer and hydraulic clutch.

FUSELAGE.—Semi-monocoque structure.

LANDING GEAR.—Conventional three-wheel undercarriage, with tail-wheel at extreme rear of fuselage. Air-oil shock absorber struts. Main wheels have rotating struts to reduce drag and weight. Tail-wheel is fully-castoring and self-centering, with an anti-swivelling lock. Main wheel tyres 11.00 × 12. Tail-wheel tyre 6.00 × 6. Toe-operated main wheel brakes. Track 12 ft. (3.66 m.). Wheelbase 28 ft. 3 in. (8.75 m.).

POWER PLANT.—One Wright R-1820-84 radial air-cooled engine, rated at 1,525 h.p. for take-off and with METO power of 1,275 h.p. for five minutes. Engine is mounted behind large clam-shell doors in nose of fuselage to allow complete accessibility from ground level. Fuel capacity is from 198 U.S. gallons (750 litres) to 307 U.S. gallons (1,164 litres) depending on model.

ACCOMMODATION.—Pilot's compartment above main cabin seats two side-by-side with dual controls. Cabin seats 12-18 passengers. Eight stretchers can be carried. Sliding windows of pilot's compartment removable in an emergency. Cabin and cockpit air-conditioned and sound-proofed.

DIMENSIONS.—
Main rotor diameter 56 ft. 0 in. (17.07 m.).
Fuselage length 47 ft. 2 in. (14.38 m.).
Height 14 ft. 4 in. (4.32 m.).

WEIGHTS (S-58).—
Weight empty 7,560 lb. (3,429 kg.).
Weight loaded 13,000 lb. (5,900 kg.).

WEIGHTS (H-34A).—
Weight empty 7,646 lb. (3,468 kg.).
Weight loaded 11,867 lb. (5,383 kg.).
Overload weight loaded 13,300 lb. (6,033 kg.).

PERFORMANCE (S-58).—
Cruising speed 101 m.p.h. (162 km.h.).
Rate of climb at S/L 1,150 ft./min. (350 m./min.).
Vertical rate of climb at S/L. 600 ft./min. (183 m./min.).
Hovering ceiling with ground effect 4,000 ft. (1,220 m.).
Hovering ceiling without ground effect 2,100 ft. (640 m.).
Service ceiling 9,600 ft. (2,925 m.).
Range (with reserve) 190 miles (305 km.).

PERFORMANCE (H-34A).—
Rate of climb at S/L. 1,500 ft./min. (457 m./min.).
Vertical rate of climb at S/L. 600 ft./min. (183 m./min.).
Hovering ceiling with ground effect 9,600 ft. (2,925 m.).
Hovering ceiling without ground effect 5,500 ft. (1,675 m.).
Service ceiling 12,000 ft. (3,660 m.).

THE SIKORSKY S-56.

U.S. Navy and Marine Corps designation: HR2S.

U.S. Army designation: H-37A Mojave.

The S-56 is a twin-engined single-rotor transport helicopter which is comparable in size to the Douglas DC-3 transport. It was designed to meet the requirements of the U.S. Marine Corps as an assault helicopter and will carry up to 23 fully-equipped troops or 24 litters or cargo.

The cabin is 30 ft. 4 in. long, 7 ft. 9 in. wide and 6 ft. 8 in. high (9.25 × 2.36 × 2.03 m.) and is fitted with hydraulically-operated clamshell nose doors. A power-operated 2,000 lb. (907 kg.) winch hoist with a monorail facilitates loading and handling cargo. It can be used to draw vehicles up the nose ramp or for making air or ground pick-ups at the rear cargo door for subsequent stowage anywhere in the cabin. Bulky loads can be carried under the aircraft in a sling which is equipped with an automatic release to deposit its load upon touch-down when set by the pilot.

The S-56 is powered by two Pratt &



The Sikorsky HSS-1 Helicopter powered by two General Electric T58 shaft-turbines, prototype of the HSS-2.



The Sikorsky H-37A Military Cargo and Troop Transport (two 2,100 h.p. Pratt & Whitney R-2800 engines).

Whitney R-2800 engines which are mounted in outboard nacelles on short wing stubs. Each engine is rated at 2,100 h.p. at 2,700 r.p.m. for five minutes, with a normal output of 1,900 h.p. at 2,600 r.p.m. But normal power is restricted in the S-56 to 1,725 h.p. and cruise power to 1,280 h.p.

Power from both engines is transmitted to the five-blade main rotor and the four-blade tail rotor, both of which are of all-metal construction and fold for easy handling and stowage aboard aircraft-carriers.

This helicopter is one of the first ever built with a retractable landing-gear and is fitted with night flying equipment. It has a hydraulic servo booster control system, and all-weather flying is made possible by installation of automatic stabilisation equipment. Normal fuel capacity is 300-400 U.S. gallons (1,135-1,515 litres) but this can be raised to 654.5 U.S. gallons (2,477 litres) for assault operations by the use of standard external underwing tanks.

Three versions of the S-56 have been built: —

HR2S-1. Basic assault transport for U.S. Marines with accommodation for pilot, co-pilot and 20 passengers or 24 litter patients or 1,900 cub. ft. (53.8 m.^{3}) cargo. Prototype XHR2S-1 made its first flight on December 18, 1953 and the first production HR2S-1 flew on October 25, 1955. In service.

HR2S-1W. Modified version of HR2S-1, with large AN/APS-20E antenna in radome under fuselage nose and additional crew members, for early warning duties.

H-37A. Adaptation of HR2S-1 for medium cargo and troop transport duties with U.S. Army. Accommodation for pilot, co-pilot, equipment operator and 23 passengers or 24 litter patients or 1,900 cub. ft. (53.8 m.^{3}) cargo. In service.

In 1956, an HR2S-1 established a new international helicopter speed record of 162.7 m.p.h. (261.8 km.h.) and two altitude with payload records, by lifting 11,050 lb. (5,000 kg.) to more than 12,000 ft. (3,660 m.) and 13,250 lb. (6,000 kg.) to 7,000 ft. (2,135 m.).

DIMENSIONS.—
Main rotor diameter 72 ft. (21.95 m.).
Tail rotor diameter 15 ft. (4.57 m.).
Fuselage length 82 ft. 10 in. (25.25 m.).
Height overall 22 ft. (6.71 m.).

WEIGHTS (H-37A).—
Weight empty 20,690 lb. (9,385 kg.).
Weight loaded (normal) 30,188 lb. (13,693 kg.).
Weight loaded (max.) 31,000 lb. (14,061 kg.).

WEIGHTS (HR2S-1).—
Weight empty (assault) 21,069 lb. (9,556 kg.).
Weight empty (cargo) 21,113 lb. (9,576 kg.).
Weight loaded 31,000 lb. (14,061 kg.).

PERFORMANCE (H-37A).—
Max. speed at S/L 130 m.p.h. (209 km.h.).
Cruising speed 115 m.p.h. (185 km.h.).
Max. rate of climb at S/L 990 ft./min. (300 m./min.).
Hovering ceiling out of ground effect 1,100 ft. (335 m.).
Service ceiling 8,700 ft. (2,650 m.).
Combat radius 69 miles (111 km.).

PERFORMANCE (HR2S-1).—
Max. speed at S/L 122 m.p.h. (196 km.h.).



The Sikorsky HR2S-1W Airborne Early Warning Helicopter (two 2,100 h.p. Pratt & Whitney R-2800 engines).



The Sikorsky H-19B Utility Helicopter (700 h.p. Wright R-1300 engine). (*Gordon Williams*).

Cruising speed 115 m.p.h. (185 km.h.).
Max. rate of climb at S/L 1,390 ft./min. (425 m./min.).
Service ceiling 8,000 ft. (2,440 m.).
Combat radius 104 miles (167 km.).

THE SIKORSKY S-55.

U.S.A.F. and U.S. Army designation: H-19.
U.S. Army name: Chickasaw.
U.S. Navy and Coast Guard designation: HO4S.
U.S. Marine Corps designation: HRS.

The S-55 is a twelve-seat utility helicopter suitable for passenger, air mail or cargo transport and for air rescue and military service. The prototype flew on November 9, 1949 and some 1,200 Sikorsky-built helicopters of the basic S-55 type had been delivered by February, 1958.

Apart from being adopted by the U.S.A.F., U.S. Army Field Forces, U.S. Navy, U.S. Marine Corps and U.S. Coast Guard, the S-55 is also being built under licence in the United Kingdom by Westland Aircraft Ltd. and in France by Sud-Aviation. The British-built S-55, known as the Westland Whirlwind, is in service with the Royal Air Force and the Royal Navy.

There are three commercial models of the S-55, as follows :—

S-55. Standard version with 600 h.p. Pratt & Whitney R-1340 engine, friction clutch and straight tail-boom.

S-55A. With 700 h.p. Wright R-1300-3 engine, hydro-mechanical clutch and inclined tail-boom. In production.

S-55C. As S-55, but with inclined tail-boom. In production.

The many U.S. naval and military versions are enumerated below :—

H-19A. 550 h.p. Pratt & Whitney R-1340-57 engine. For U.S.A.F. A.U.W. 7,200 lb. (3,263 kg.). Crew of two, plus ten troops or six stretchers.

H-19B. 700 h.p. Wright R-1300-3 engine. For U.S.A.F. Rotor diameter 53 ft. (16.16 m.). A.U.W. 7,500 lb. (3,900 kg.). Crew of two, plus ten troops or six stretchers.

H-19C. Same as H-19A for U.S. Army Field Forces.

H-19D. Same as H-19B for U.S. Army Field Forces.

HO4S-1 and -2. 550 h.p. Pratt & Whitney R-1340 engine. Similar to H-19A. For U.S. Navy for anti-submarine duties.

HO4S-2G. For U.S. Coast Guard. HO4S-2 fitted for rescue duties.

HO4S-3. 700 h.p. Wright R-1300 engine. Similar to H-19B. For U.S. Navy for anti-submarine duties.

HRS-1 and -2. 550 h.p. Pratt & Whitney R-1340 engine. Similar to H-19A. For U.S. Marine Corps for assault transport duties. Crew of two and eight fully-armed troops.

HRS-3. 700 h.p. Wright R-1300 engine. Similar to H-19B. U.S. Marine Corps assault transport.

The description and specification which follow refer in general to all current production models.

Type.—Twelve-seat Utility Helicopter.

Rotors.—Three-blade main rotor and two-blade anti-torque tail rotor. All-metal structures.

Fuselage.—Except for the chrome-molybdenum steel-tube rotor pylon, structure is of aluminium and magnesium semi-monocoque construction. On current commercial S-55C's and the versions with R-1300 engine, the tail cone has been sloped down approximately $3\frac{1}{2}°$ to increase clearance of main rotor in a rough landing.

Landing Gear.—Quadricycle type. Wheel track 11 ft. (3.35 m.). Alternative gear includes all-metal amphibious landing-gear or permanently-inflated rubber bag flotation gear. For use with the normal wheels, "doughnut" pontoons are available which are stowed deflated on each wheel axle and can be inflated in under 5 sec. when needed for landing on water.

Power Plant.—One Pratt & Whitney R-1340 S3H2 Wasp radial air-cooled engine rated at 550 h.p. at 5,000 ft. (1,525 m.) and with 600 h.p. available for take-off at 3,000 ft. (915 m.), or one Pratt & Whitney R-1340 S1H2 Wasp rated at 550 h.p. at 8,000 ft. (2,440 m.) and with 600 h.p. available for take-off at 6,200 ft (1,900 m.), or one Wright R-1300-3 radial air-cooled engine rated at 700 h.p. at 7,300 ft. (2,222 m.) and with 800 h.p. available for take-off at 5,500 ft. (1,675 m.). Engine on angular mounting in nose of fuselage with sloping shaft drive to rotor gear box below head. With the R-1300 engine, a hydro-mechanical clutch with freewheel system is used in the drive to the main transmission, and the drive-shaft from the freewheel unit to the



The Sikorsky HO4S-3 Naval General Utility Helicopter (700 h.p. Wright R-1300 engine). (*Harold Martin*).



The Sikorsky S-55 Commercial Helicopter (600 h.p. Pratt & Whitney R-1340 engine).

main transmission has flexible rubber couplings on each end. Large clam-shell doors in nose of fuselage allow complete accessibility to engine from ground level. Internal fuel capacity 185 U.S. gallons (700 litres).

ACCOMMODATION.—Pilot's compartment above main cabin seats two side-by-side with dual controls. Cabin located below main lifting rotor may seat from seven (commercial) to ten (military) passengers, the ten passengers being seated three against front and rear walls and two on each side, all facing inwards. Up to six stretchers may be carried, which can be loaded by optional hydraulic power-operated hoist while aircraft is hovering. Pilot's compartment may be entered from the outside or from the cabin so that co-pilot may act as attendant. Cabin dimensions: length 10 ft. (3.05 m.), width 5 ft. 2 in. (1.58 m.), height 6 ft. (1.82 m.). Total capacity 340 cub. ft. (9.6 m.³).

DIMENSIONS.—
Main rotor diameter 53 ft. (16.16 m.).
Tail rotor diameter 8 ft. 9 in. (2.67 m.).
Fuselage length 42 ft. 2 in. (12.85 m.).
Height overall 13 ft. 4 in. (4.07 m.).

WEIGHTS (R-1340 engine).—
Weight empty 4,950 lb. (2,245 kg.).
Max. disposable load 2,250 lb. (1,021 kg.).
Normal weight loaded 7,200 lb. (3,266 kg.).
Overload max. weight (military versions) 7,900 lb. (3,583 kg.) with 2,632 lb. (1,195 kg.) payload.

WEIGHTS (R-1300 engine).—
Weight empty 5,250 lb. (2,381 kg.).
Max. disposable load 2,250 lb. (1,021 kg.).
Weight loaded 7,500 lb. (3,402 kg.).
Overload max. weight (military versions) 7,950 lb. (3,606 kg.).

PERFORMANCE (R-1340 engine at A.U.W. of 7,200 lb.=3,263 kg.).—
Max. speed at S/L. 101 m.p.h. (162 km.h.).
Cruising speed (67% power) at 1,000 ft. (305 m.) 85 m.p.h. (137 km.h.).
Max. rate of climb at S/L. 700 ft./min. (213 m./min.).
Hovering ceiling with ground effect 6,400 ft. (1,950 m.) at 6,600 lb. (2,995 kg.) A.U.W.
Service ceiling 9,800 ft. (2,990 m.).
Fuel consumption (cruising) 37 U.S. gallons (140 litres) per hour.
Range (with reserve) 405 miles (650 km.).
Range (at 7,900 lb.=3,583 kg. A.U.W.) 370 miles (595 km.) at 75 m.p.h. (121 km.h.).

PERFORMANCE (R-1300 engine).—
Max. speed at S/L. 112 m.p.h. (180 km.h.).
Cruising speed (65% power) 91 m.p.h. (148 km.h.).
Max. rate of climb at S/L. 1,020 ft./min. (311 m./min.).
Vertical rate of climb at S/L. 100 ft./min. (35 m./min.).
Hovering ceiling with ground effect 5,800 ft. (1,770 m.).
Hovering ceiling without ground effect 2,300 ft. (700 m.).
Service ceiling 10,600 ft. (3,230 m.).
Fuel consumption (cruising) 43 U.S. gallons (163 litres) per hour.
Range (with reserve) 360 miles (578 km.).

SILVAIRE

SILVAIRE AIRCRAFT COMPANY.

HEAD OFFICE AND WORKS: P.O. BOX 719, FORT COLLINS, COLORADO.

President: Otis T. Massey.

The Silvaire Aircraft Corporation is manufacturing the all-metal Luscombe Model 8 Silvaire light cabin monoplane, the original prototype of which was designed and built by Don Luscombe at the Mercer Airport, Trenton, New Jersey, in 1936.

At the end of World War 2, the tooling, dies and other equipment to manufacture the Silvaire were moved by the Luscombe Airplane Corporation to Dallas, Texas, where production was resumed. In 1949, this company was purchased by the Temco Aircraft Corporation, which built about 50 Silvaires before suspending production to concentrate on military commitments.

In January, 1955, Otis T. Massey purchased the manufacturing rights and equipment for the Model 8 Silvaire from Temco and put it into production at Fort Collins, Colorado. The first aircraft off the new line flew in September, 1956.

THE SILVAIRE MODEL 8-F.

TYPE.—Two-seat Light cabin monoplane.

WINGS.—Braced high-wing monoplane. All-metal two-spar stressed-skin structure, with only two ribs in each wing. Single non-welded bracing strut each side. All-metal ailerons. Flaps optional. Total area of ailerons 14.75 sq. ft. (1.37 m.²). Gross wing area 140 sq. ft. (13.0 m.²).

FUSELAGE.—All-metal semi-monocoque structure with strengthened "safety-zone" cabin.

TAIL UNIT.—Cantilever monoplane type. All-metal structure. Trim-tab in port elevator. Areas: fin 4.72 sq. ft. (0.44 m.²), rudder 5.65 sq. ft. (0.53 m.²), tailplane 14.50 sq. ft. (1.35 m.²), elevators 8.75 sq. ft. (0.81 m.²).

LANDING GEAR.—Non-retractable "Silflex" tail-wheel type. Cantilever tubular-steel Vee main units with combination coil spring-oleo shock absorbers. Fully-castoring steerable tail-wheel. Wheel fairings optional. Heel-operated Cleveland or Goodyear mechanical brakes and manual parking brake. Cleveland or Goodyear main wheels 600×6. Tail-wheel 6×2.00. Wheel track 6 ft. 4 in. (1.93 m.). Alternative float landing gear.

POWER PLANT.—One Continental C90-12F four-cylinder horizontally-opposed air-cooled engine with maximum rated power of 90 h.p. at 2,475 r.p.m. and normal cruising power of 73 h.p. at 2,300 r.p.m. Two-blade metal fixed-pitch airscrew, diameter 5 ft. 11 in. (1.80 m.). Fuel in two metal tanks in wings, each with capacity of 12.5 U.S. gallons (47.3 litres). Oil capacity 5 U.S. quarts (4.7 litres).

ACCOMMODATION.—Two seats side-by-side in cabin with dual controls. Compartment for 75 lb. (34 kg.) baggage aft of seats or alternative temporary seat for a child. Map shelf. Cabin heater and ventilators. Doors on each side of cabin with opening windows. Maximum height of cabin 3 ft. 2¾ in. (0.98 m.). Maximum width of cabin 3 ft. 3 in. (0.99 m.).

DIMENSIONS.—
Span 35 ft. (10.67 m.).



The Silvaire Model 8-F (90 h.p. Continental C90 engine).

Length 20 ft. (6.10 m.).
Height 6 ft. 3 in. (1.90 m.).
WEIGHTS AND LOADINGS.—
Weight empty 870 lb. (395 kg.).
Weight loaded 1,400 lb. (635 kg.).
Wing loading 10 lb./sq. ft. (48.8 kg./m.²).
Power loading 15.6 lb./h.p. (7.07 kg./h.p.).
PERFORMANCE.—
Max. speed 128 m.p.h. (206 km.h.).
Cruising speed 120 m.p.h. (193 km.h.).
Stalling speed, flaps down 40 m.p.h. (64.4 km.h.).
Stalling speed, no flaps 48 m.p.h. (77.2 km.h.).
Rate of climb at S/L. 900 ft./min. (274 m./min.).
Service ceiling 17,000 ft. (5,180 m.).
Absolute ceiling 17,500 ft. (5,335 m.).
Take-off run 550 ft. (168 m.).
Landing run 450 ft. (137 m.).
Normal range over 500 miles (805 km.).

STITS

STITS AIRCRAFT.

HEAD OFFICE AND WORKS: P.O. Box 3084, WEST RIVERSIDE AIRPORT, RIVERSIDE, CALIFORNIA.

Between 1948 and 1952 Mr. Ray Stits designed, built and tested his original single-seat experimental "midgets." The Stits Junior, a monoplane with a span of 8 ft. 10 in. was superseded by the Sky Baby biplane with a span of only 7 ft. 2 in. They have been respectively described by their designer as the "World's Smallest."

More recent designs are the Sky-Coupe, Playboy and Flut-R-Bug. They are intended for construction at home by amateurs and are available only in the form of constructional drawings and raw materials. The manufacture of construction kits and parts has been discontinued.



The Stits SA-7 Sky-Coupe (65 h.p. Continental A65 engine).

THE STITS SA-7 SKY-COUPE.

TYPE.—Two-seat light monoplane.
WINGS.—Strut-braced high-wing monoplane. NACA 4412 wing section. Aspect ratio 5. Chord 5 ft. (1.52 m.). Dihedral 3°. Incidence 3°. All-wood two-spar constant-chord structure. Fabric covering. Full-span metal ailerons droop for use as landing flaps. Total area of ailerons 12 sq. ft. (1.11 m.²). Gross wing area 120 sq. ft. (11.15 m.²). Constant chord structure with spruce spars, plywood ribs, and fabric covering. Tubular metal bracing struts. Wing area 130 sq. ft. (12.08 m.²).
FUSELAGE.—Chrome-molybdenum steel tube framework with fabric covering.
TAIL UNIT.—Braced monoplane type. Chrome-molybdenum steel tube structure, with fabric covering.
LANDING GEAR.—Fixed nose-wheel type. Steerable nose-wheel. Tyres 4.00×8, 4-ply. Spats are optional.
POWER PLANT.—Either one 65 h.p. Continental A65 or one 85 h.p. Continental C85 four-cylinder, horizontally-opposed air-cooled engine. Tubular steel mounting is standard for Continental range of engines from A65 to C90. Wooden two-blade fixed-pitch airscrew. Fuel capacity 13½ U.S. gallons (51 litres).
ACCOMMODATION.—Two seats in tandem under hinged canopy. Optional canvas compartment aft of seats for 20 lb. (9 kg.) baggage.
DIMENSIONS.—
Span 26 ft. (7.92 m.).
Length 18 ft. (5.49 m.).
Height 6 ft. (1.83 m.).
WEIGHTS AND LOADINGS (A65 engine).—
Weight empty 575 lb. (261 kg.).
Weight loaded 1,031 lb. (468 kg.).
Wing loading 7.9 lb./sq. ft. (38.57 kg./m.²).
PERFORMANCE (A65 engine).—
Max. speed 100 m.p.h. (160 km.h.).
Cruising speed 90 m.p.h. 145 km.h.).
Stalling speed (power off) 38 m.p.h. (61 km.h.).
Rate of climb at S/L. over 1,000 ft./min. (305 m./min.).
Service ceiling over 12,000 ft. (3,660 m.).
Take-off distance 300 ft. (91 m.).
Range over 250 miles (400 km.).
PERFORMANCE (C85 engine).—
Max. speed 115 m.p.h. (184 km.h.).
Cruising speed 105 m.p.h. (168 km.h.).
Rate of climb over 1,000 ft./min. (305 m./min.).
Service ceiling over 14,000 ft. (4,270 m.).
Take-off distance 250 ft. (76 m.).



The Stits SA-6B Flut-R-Bug (65 h.p. Continental A65 engine).

FUSELAGE.—Welded chrome-molybdenum steel-tube structure. Fabric covered.
TAIL UNIT.—Braced monoplane type. Welded chrome-molybdenum steel-tube structure. Fabric covered.
LANDING GEAR.—Fixed tricycle type. Rubber-cord shock-absorption on main wheels. Compression spring shock-absorber on nose-wheel. Industrial 4:00 × 8 steel wheels. Manually-operated mechanical brakes.
POWER PLANT.—One 65 h.p. Continental A65 four-cylinder horizontally-opposed air-cooled engine driving two-blade wood or metal airscrew. (Other Continental engines in the 65-90 h.p. range may be fitted in production aircraft). One 17 U.S. gallon (64.3 litres) fuel tank aft of firewall. Oil capacity 1 U.S. gallon (3.75 litres).
ACCOMMODATION.—Two seats side-by-side in enclosed cockpit, with dual controls. Width inside cabin 38 in. (96.5 cm.). Space for 30 lb. (13.6 kg.) baggage aft of seats.
DIMENSIONS.—
Span 24 ft. 4 in. (7.42 m.).
Length 17 ft. 9 in. (5.40 m.).
Height 6 ft. 3 in. (1.90 m.).
WEIGHTS (Continental A65 engine).—
Weight empty 600 lb. (272 kg.).
Weight loaded 1,080 lb. (490 kg.).
PERFORMANCE (Continental A65 engine).—
Max. speed 100 m.p.h. (160 km.h.).
Cruising speed 90 m.p.h. (145 km.h.).
Stalling speed 35 m.p.h. (56.3 km.h.).
Rate of climb at S/L. over 1,000 ft./min. (305 m./min.).
Service ceiling over 12,000 ft. (3,660 m.).
Take-off distance 300 ft. (91 m.).
Range, with reserve, 300 miles (483 km.).

THE STITS SA-6B FLUT-R-BUG.

TYPE.—Two-seat light monoplane.
WINGS.—Strut-braced mid-wing monoplane.

THE STITS SA-3A PLAYBOY.

TYPE.—Single-seat light monoplane.
WINGS.—Strut-braced low-wing monoplane. Constant chord structure with spruce spars, plywood ribs, plywood-covered leading-edge and overall fabric covering. Steel tube bracing struts. Ailerons are of wooden construction and fabric-covered. Wing area 96 sq. ft. (8.9 m.²).
FUSELAGE.—Chrome-molybdenum steel tube framework with fabric covering.
TAIL UNIT.—Wire-braced monoplane type. Controllable trim-tab in port elevator only.
LANDING GEAR.—Fixed tail-wheel type. Oleo shock-absorbers. Spats are optional. Leaf-spring tailwheel.
POWER PLANT.—One 85 h.p. Continental C85 four-cylinder horizontally-opposed air-cooled engine. Engine mounting standard for Continental range of engines from A65 to C90. Wooden two-blade fixed-pitch airscrew. Fuel capacity 14 U.S. gallons (53 litres).
ACCOMMODATION.—Single-seat open cockpit (enclosed hood optional). Compartment for 40 lb. (18 kg.) baggage.
DIMENSIONS.—
Span 22 ft. 2 in. (6.76 m.).
Length 17 ft. 4 in. (5.28 m.).
WEIGHTS AND LOADINGS.—
Weight empty 600 lb. (272 kg.).
Disposable load 302 lb. (137 kg.).
Weight loaded 902 lb. (409 kg.).
Wing loading 9.0 lb./sq. ft. (43.92 kg./m.²).
Power loading 10.6 lb./h.p. (4.81 kg./h.p.).
PERFORMANCE.—
Max. speed over 145 m.p.h. (232 km.h.).
Cruising speed over 130 m.p.h. (178 km.h.).
Stalling speed 45 m.p.h. (72 km.h.).
Initial rate of climb over 1,000 ft./min. (305 m./min.).
Service ceiling over 12,000 ft. (3,660 m.).



The Stits SA-3A Playboy (85 h.p. Continental C85 engine).

Take-off (against 10 m.p.h. wind) less than 300 ft. (91.5 m.).

THE STITS SA-3B PLAYBOY.

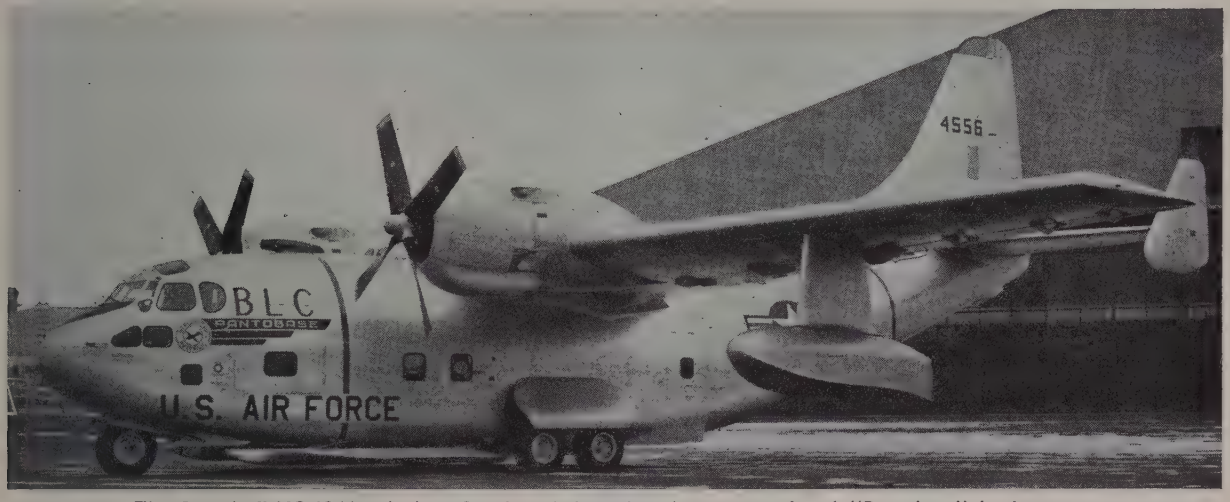
This is a two-seat version of the SA-3A fitted with dual controls and an electrical system. Power is increased by installing a 150 h.p. Lycoming O-320 engine, with a total of 36 U.S. gallons (136 litres) of fuel in two tanks.

DIMENSIONS.—
Span 24 ft. 2 in. (7.37 m.).
Length 17 ft. 10 in. (5.43 m.).
Wing area 108 sq. ft. (10.03 m.²).

WEIGHTS.—
Weight empty 795 lb. (360 kg.).
Weight loaded 1,450 lb. (658 kg.).

PERFORMANCE.—
Max. speed 150 m.p.h. (241 km.h.).
Cruising speed 140 m.p.h. (225 km.h.).
Stalling speed 55 m.p.h. (89 km.h.).
Initial rate of climb over 1,000 ft./min. (305 m./min.).
Take-off distance 200 ft. (61 m.).

STROUKOFF



The Stroukoff YC-134A which is fitted with boundary layer control and "Pantobase" landing-gear.

STROUKOFF AIRCRAFT CORPORATION.

HEAD OFFICE AND WORKS: MERCER AIRPORT, WEST TRENTON, NEW JERSEY.

President and Chief Engineer: Michael Stroukoff.

Vice-President and Treasurer: Oleg Stroukoff.

Assistant Chief Engineers: L. J. Stowe and S. W. Rogalski.

The Stroukoff Aircraft Corporation was formed by Mr. Stroukoff after the controlling interest in the Chase Aircraft Company, Inc., of which he was Vice-President and Chief Engineer, was acquired by the Kaiser-Frazer Corporation. Mr. Stroukoff was responsible for the design of the Chase C-123. A production order for 300 C-123B's held by the Kaiser-Frazer Corporation was cancelled in 1953. After new bids had been asked for, production of the C-123B was assigned to the Fairchild Engine and Airplane Corporation, to which reference should be made for a description of this aircraft.

The Stroukoff Aircraft Corporation is undertaking considerable development work with the basic C-123 design. The company was awarded a U.S.A.F. contract for the construction and development of a test version of the C-123 fitted with boundary-layer control. The first aircraft so equipped, the XC-123D, first flew on December 7, 1954. Preliminary tests at the Wright Air Development Center showed that with boundary-layer control the take-off distance of the XC-123D at 50,000 lb. (22,700 kg.) A.U.W. was reduced from 1,950 ft. (595 m.) to 850 ft. (250 m.) and the landing run from 1,200 ft. (366 m.) to 755 ft. (230 m.).

As a result of the success of the XC-123D, Stroukoff was awarded a contract to build a production development for the U.S.A.F. under the designation of YC-134, and the prototype of this aircraft flew for the first time on December 19, 1956.

This was followed by a pre-production series of three YC-134A aircraft, the first of which flew on January 23, 1958. The YC-134A incorporates both boundary layer control and the Stroukoff-developed Pantobase landing gear which permits operation from water, sand, swamp, snow, ice and almost any unprepared but fairly smooth natural surface.

THE STROUKOFF MS-8-1, BLC PANTOBASE.

U.S.A.F. designation: YC-134A.

The YC-134A incorporates both boundary layer control and the Stroukoff Pantobase landing system. The first of three pre-production YC-134A's flew for the first time on January 23, 1958, and was delivered to the U.S.A.F. on February 21, 1958.

The boundary layer control system makes it possible for this 70,000-lb. (32,000-kg.) aircraft to achieve remarkably short take-offs and landings, while the Pantobase landing gear permits operation on any unprepared surface, as well as ice, snow, water, sand, swamp or tundra.

TYPE.—Twin-engined Experimental Assault Transport.

WINGS.—High-wing cantilever monoplane. Aspect ratio 9.8. Wing section MS8-016.64. Mean chord 11 ft. 8 in. (3.55 m.). Dihedral 1° 18'. Incidence 8° at root, 4° at tip. Two-spar aluminium-alloy structure. Aluminium-alloy ailerons and flaps. Total area of ailerons 82.9 sq. ft. (7.70 m.²). Total area of flaps 222.1 sq. ft. (20.53 m.²). Gross wing area 1,234.9 sq. ft. (114.73 m.²).

FUSELAGE.—Aluminium-alloy semi-monocoque structure. Lower part of fuselage is sealed for flotation.

TAIL UNIT.—Cantilever monoplane type with auxiliary fins and rudders on tips of tailplane. Aluminium-alloy structure. Areas: fins (3) 231.6 sq. ft. (21.51 m²., rudders (3) 96.6 sq. ft. (8.97 m.²), elevators 126.4 sq. ft. (11.74 m.²), tailplane 219.6 sq. ft. (20.4 m.²). Tailplane span 39 ft. 2 in. (11.94 m.).

LANDING GEAR.— "Pantobase" type incorporating retractable land and water skis, wheels and wing-tip floats. Cleveland Pneumatic air-oil shock-absorbers. Hydraulic retraction. Tandem-wheel main units retract into fuselage. Single nose-wheel. Goodyear aluminium-alloy amphibious type wheels. Goodyear spot brakes. Wheel track 15 ft. 10 in. (4.83 m.). Wheelbase 26 ft. 8 in. (8.17 m.).

POWER PLANT.—Two 3,500 h.p. Wright R-3350-89A Turbo Compound eighteen-cylinder two-row radial air-cooled engines, driving Aeroproducts Model A644FN-C2 four-blade fully-feathering constant-speed airscrews. Fuel in two centre-section tanks, each with capacity of 516 U.S. gallons (1,950 litres). Total internal fuel capacity 1,032 U.S. gallons (3,900 litres). Two wing-tip float tanks each with capacity of 500 U.S. gallons (1,890 litres). Oil capacity 84.4 U.S. gallons (319 litres).

ACCOMMODATION.—Flight compartment in nose. Large cargo hold with floor at truck-bed height. Floor stressed for heavy concentrated loads. Loading either through wide tail gate ramp and door systems or through large forward cargo door.

DIMENSIONS.—
Span 110 ft. 0 in. (33.55 m.).
Length 82 ft. 0¾ in. (25.0 m.).
Height 34 ft. 8½ in. (10.50 m.).

WEIGHTS.—
Weight empty, equipped 40,391 lb. (18,337 kg.).
Weight loaded 74,700 lb. (33,884 kg.).

PERFORMANCE.—
Cruising speed 250 m.p.h. (400 km.h.) at 10,000 ft. (3,050 m.).
Take-off distance on land 740 ft. (225 m.).
Take-off distance on water 1,250 ft. (380 m.).
Landing distance on land 550 ft. (168 m.).
Landing distance on water 750 ft. (229 m.).
Range with 24,000 lb. (10,885 kg.) payload 1,610 miles (2,595 km.).

SUPERIOR

SUPERIOR AIRCRAFT COMPANY (Division of the Priestley Hunt Aircraft Corporation).

HEAD OFFICE AND WORKS: 5673, SELMARAINE DRIVE, CULVER CITY, CALIFORNIA.

President and Chief Engineer: R. G. Hunt.

Vice-President and Chief Aerodynamicist: R. Thomas Priestley.

Treasurer: John Lamb.

Sales Manager: Bennet Rogers.

The Superior Aircraft Company was formed in mid-1956 to acquire the assets of the Culver Aircraft Corporation which went bankrupt in late 1946.

Culver was a pioneer in the design and construction of light aircraft in the late 30's and early 40's. During the last war Culver was engaged in the development and production of radio-controlled target drones for the U.S. forces. Three basic models were built for the Army (PQ Series), with corresponding versions for the Navy (TDC Series), and at the end of hostilities Culver produced for the civil market the Model V two-seat cabin monoplane which incorporated many features developed for the PQ Series drones. The expected boom in private flying did not materialise and Culver was forced to close down.

The design of the Model V, dormant

for ten years, has now been acquired by the Superior Aircraft Company, whose Satellite is a development of the Model V design with increased power and other refinements.

The first production Satellite flew for the first time on December 20, 1957.



The Superior Satellite (90 h.p. Continental C90 engine).

THE SUPERIOR SATELLITE.

TYPE.—Two-seat cabin monoplane.

WINGS.—Low-wing cantilever monoplane. Aspect ratio 6.7. Chord at root 5 ft. 6 in. (1.67 m.). Dihedral 2° 40′ main wing, 10° tip. Incidence 1.5°. Resin-bonded spruce and plywood structure for wings, ailerons and slotted flaps. Total aileron area 7.5 sq. ft. (0.69 m.²). Total flap area 24.5 sq. ft. (2.27 m.²). Gross wing area 126 sq. ft. (11.7 m.²).

FUSELAGE.—Resin-bonded spruce and plywood monocoque.

TAIL UNIT.—Cantilever monoplane type. Resin-bonded spruce and plywood structure. Areas: fin 5.5 sq. ft. (0.51 m.²), rudder 4.5 sq. ft. (0.42 m.²), tailplane 19.3 sq. ft. (1.81 m.²), elevator 4.9 sq. ft. (0.45 m.²). Span of tailplane 9 ft. 2 in. (2.79 m.).

LANDING GEAR.—Retractable tricycle type. Electric actuation. Air-oil shock-absorbers. Steerable nose-wheel. Firestone wheels, tyres and hydraulic brakes. Track 8 ft. 1 in. (2.45 m.). Wheelbase 4 ft. 8 in. (1.42 m.).

POWER PLANT.—One 90 h.p. Continental C90 four-cylinder horizontally-opposed air-cooled engine. Sensenich "Skyblade" hydraulic controllable-pitch airscrew. Two fuel tanks in leading-edge of wings, one on each side. Total fuel capacity 32 U.S. gallons (121 litres).

ACCOMMODATION.—Enclosed cabin seating two side-by-side with dual controls. Heating and ventilation.

DIMENSIONS.—
Span 29 ft. (8.83 m.).
Length 20 ft. 8 in. (6.30 m.).
Height 6 ft. 10 in. (2.08 m.).

WEIGHTS.—
Weight empty 1,030 lb. (468 kg.).
Disposable load 570 lb. (259 kg.).
Weight loaded 1,600 lb. (727 kg.).

PERFORMANCE.—
Cruising speed 130 m.p.h. (208 km.h.).
Stalling speed 55 m.p.h. (88 km.h.).
Rate of climb at S/L 750 ft./min. (230 m./min.).
Range 700 miles (1,120 km.).
Take-off run 800 ft. (244 m.).
Take-off to clear 50 ft. (15.25 m.) 1,600 ft. (488 m.).

TAYLORCRAFT

TAYLORCRAFT, INC.

HEAD OFFICE AND WORKS: CONWAY-PITTSBURGH AIRPORT, CONWAY, PA.
President: B. J. Mauro.
Vice-President: C. G. Taylor.
Chief Engineer: J. Gilberti.
Assistant Chief Engineer: C. Hodgekin.
Production Manager: G. M. Owen.

Taylorcraft, Inc. is the successor to the Taylorcraft Aviation Corporation. It was reformed by Mr. C. G. Taylor, founder of the original Taylor Aircraft Company and designer of the original Cub light cabin monoplane, who acquired the assets of the defunct Taylorcraft concern.

In 1955 Taylorcraft introduced a new form of structure for light aircraft using moulded Fiberglas as a covering for fuselage and wings as well as for the engine cowling, doors, seats, fuel tanks, instrument panel, etc. Only the rudder and elevators are fabric-covered.

This new material, which is supplied by the Owens Corning Fiberglas Corporation, combines great strength with light weight and almost complete resistance to corrosion. It will not dent, warp or tear, and presents a superfine external finish.

The first three aircraft incorporating this form of construction are the Zephyr 400, Seabird and Topper, described below.



The Taylorcraft Zephyr 400 (225 h.p. Continental O-470-J engine).

THE TAYLORCRAFT MODEL 20 ZEPHYR 400.

TYPE.—Four-seat light cabin monoplane, quickly convertible for light cargo-carrying.

WINGS.—High-wing rigidly-braced monoplane. Wing section Göttingen 532. Aspect ratio 7.11. Dihedral 1°. Chord 6 ft. 2¼ in. (1.89 m.). Two-spar light alloy structure covered with moulded Fiberglas skin. All-aluminium slotted flaps and ailerons. Slotted wing-tips. Total area of flaps 14.3 sq. ft. (1.33 m.²)- Total area of ailerons 14.38 sq. ft. (1.36 m.²). Gross wing area 178.5 sq. ft. (16.58 m.²).

FUSELAGE.—Welded steel tube framework. Fiberglas covering is moulded in two half sections extending from fireproof bulkhead to rudder-post, including fin, and is attached directly to fuselage framework and upper and lower joints sealed.

TAIL UNIT.—Braced monoplane type. Fin integral with fuselage. Welded steel tube frames for tailplane, elevators and rudder, the tailplane covered with Fiberglas and the elevators and rudder with fabric. Areas: fin 9.35 sq. ft. (0.86 m.²), rudder 9.36 sq. ft. (0.87 m.²), tailplane 15.84 sq. ft. (1.47 m.²), elevators 13.98 sq. ft. (1.29 m.²). Span of tail 11 ft. 10½ in. (3.63 m.).

LANDING GEAR.—Fixed tail-wheel type. Two faired side vees and two half axles, the latter fitted with air-oil shock-absorbers. Cleveland wheels and C2000H brakes. Steerable tail-wheel. Track 6 ft. 3 in. (1.90 m.).

POWER PLANT.—One 225 h.p. Continental O-470-J six-cylinder horizontally-opposed air-cooled engine. McCauley metal fixed-pitch airscrew. Optionally Hartzell or McCauley constant-speed airscrew can be fitted. Three Fiberglas fuel tanks (22 U.S. gallons=83 litres). Total fuel capacity 66 U.S. gallons (250 litres). Oil capacity 3 U.S. gallons (11.3 litres).

ACCOMMODATION.—Enclosed cabin seats four, two in front with dual wheel controls. Individual rear seats can be instantly removed to provide cargo space. The starboard front seat alongside the pilot can also be removed and the space made available for cargo. Large baggage compartment behind rear seats. Doors on either side of front seats, and a special wide cargo door may be installed on starboard side of rear compartment.

DIMENSIONS.—
Span 34 ft. 8 in. (10.57 m.).
Length 24 ft. 4 in. (7.42 m.).
Height 7 ft. 1$\frac{1}{16}$ in. (2.16 m.).

WEIGHTS AND LOADINGS.—
Weight empty 1,625 lb. (738 kg.).
Disposable load 1,125 lb. (511 kg.).
Weight loaded 2,750 lb. (1,249 kg.).
Wing loading 15.4 lb./sq. ft. (75.15 kg./m.²).
Power loading 12.2 lb./h.p. (5.54 kg./h.p.).



The Taylorcraft Seabird (225 h.p. Continental O-470-J engine).

PERFORMANCE (constant-speed airscrew).—
Max. speed 160 m.p.h. (256 km.h.).
Cruising speed 150 m.p.h. (240 km.h.).
Initial rate of climb 1,000 ft./min. (305 m./min.).
Service ceiling 15,000 ft. (4,575 m.).
Cruising endurance 5 hours.

THE TAYLORCRAFT SEABIRD.

The Seabird is a floatplane version of the Zephyr 400, to which it is similar in almost all rospects, except for its landing gear. This consists of two Edo Type 249-2870 floats which are made, like the skin of the airframe, from Fiberglas. It is claimed that this method of construction will reduce the possibility of damage if the floats hit drifting objects on the water.

Like the Zephyr 400, the Seabird has a 225 h.p. Continental O-470-J engine. This normally drives a Hartzell constant-speed airscrew, but a McCauley constant-speed airscrew can be supplied as an alternative.

DIMENSIONS.—
Same as Zephyr 400.
WEIGHTS AND LOADINGS.—
Weight empty 2,020 lb. (916 kg.).
Weight loaded 3,040 lb. (1,379 kg.).
Wing loading 17 lb./sq. ft. (83 kg./m.²).
Power loading 13.5 lb./h.p. (6.13 kg./h.p.).
PERFORMANCE.—
Max. speed 140 m.p.h. (225 km.h.).
Cruising speed 130 m.p.h. (209 km.h.).
Rate of climb at S/L. 790 ft./min. (240 m./min.).



The Taylorcraft Topper (225 h.p. Continental O-470-J engine).

Service ceiling 14,000 ft. (4,270 m.).
Endurance 5 hr.

THE TAYLORCRAFT MODEL 20AG TOPPER.

The Topper is similar to the Zephyr 400 but is intended for agricultural use. Provision is made for the installation of a dust hopper or spray tank in the rear half of the cabin and there is a power take-off on the engine for operating a spray pump. The pilot is seated centrally in front and has stick control. There is one door on the right side of the front compartment.

The structure, power-plant and dimensions of the Topper and Zephyr 400 are identical. The Topper has two Fiberglas fuel tanks with a total capacity of 46 U.S. gallons (174 litres).

DIMENSIONS—
Same as Zephyr 400.
WEIGHTS AND LOADINGS.—
Weight empty 1,635 lb. (742 kg.).
Max. payload, with 44 U.S. gallons (167 litres) fuel and 3 U.S. gallons (11.3 litres) oil, 1,690 lb. (767 kg.).
Max. permissible loaded weight 3,767 lb. (1,709 kg.).
Max. wing loading 21.1 lb./sq. ft. (103 kg./m.²).
Max. power loading 16.74 lb./h.p. (7.60 kg./h.p.).
PERFORMANCE.—
Max. speed 115 m.p.h. (184 km.h.).
Cruising speed 100 m.p.h. (160 km.h.).
Initial rate of climb 1,000 ft./min. (305 m./min.).
Service ceiling 15,000 ft. (4,575 m.).

TEMCO

TEMCO AIRCRAFT CORPORATION.

HEAD OFFICE AND WORKS: P.O. BOX 6191, DALLAS 22, TEXAS.
OTHER FACTORIES: GARLAND AND GREENVILLE, TEXAS.
President and General Manager: Robert McCulloch.
Executive Vice-President and Treasurer: H. L. Howard.
Vice-President, Sales, Contracts and Programming: J. A. Maxwell, Jr.
Vice-President, Comptroller: Clyde Williams.
Vice-President, Engineering: I. Nevin Palley.
Vice-President, Operations: V. N. Ferguson.
Corporate Secretary: W. L. Leeds.

Temco, in addition to turning out major sub-assemblies for many of the latest U.S. military aircraft, is now established in the prime contract field following design and development of its TT-1 jet trainer, the XKDT-1 rocket-powered target drone, and the Corvus air-to-surface missile weapons system.

The TT-1, which is in production for the U.S. Navy, was the first Temco-designed jet aircraft and was the first primary jet trainer to be accepted by any of the U.S. Military services. It is being developed, under the company designation of TTX, with a more powerful turbojet to enable it to undertake an increasing part of the all-jet training syllabus.

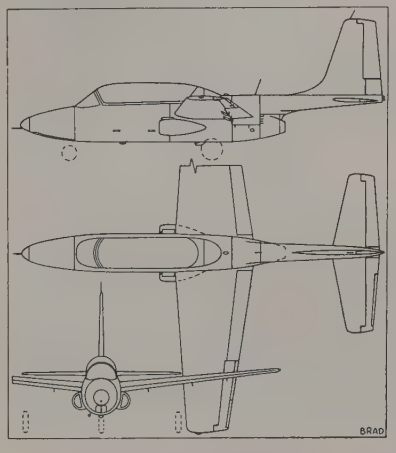
Temco is also engaged on research and development of new electronic devices; and has acquired an 80% interest in the Los Angeles electronics company of Fenske, Fedrick and Miller, Inc.

Despite the added emphasis on design and development, a major proportion of Temco's business continues to be manufacture of sub-assemblies, plus modification and overhaul of military aircraft. Temco holds contracts for the manufacture of major components for the Boeing B-52; McDonnell F3H, F-101 and RF-101; Lockheed F-104, P2V-7, C-130 and Electra; Fairchild C-123 and for the Pratt & Whitney J57 turbojet engine.

The company also continued during 1958 a varied and intensive electronic modification and overhaul programme, at the Greenville plant. Military contracts included modifying of such aircraft as the Boeing C-97 and RB-50 and the Douglas C-54.

Temco also undertakes special contractural modification. One such job was modification of a B-57 bomber by attaching a simulated Bomarc missile nose onto its fuselage. This was done under a contract from the Boeing Airplane Company.

An expanded research and development programme has necessitated construction of a new 100,000 sq. ft. engineering building at the Garland plant. A new corporate headquarters building at the Garland plant also was completed and occupied during 1957.



The Temco TT-1 Pinto.

THE TEMCO MODEL 51 PINTO

U.S. Navy designation: TT-1.

The Temco Model 51 was the first primary jet trainer accepted by one of the U.S. military services. It was stressed for an ultimate load of 11.25 "g" and extra structural strength was built into the airframe to permit the installation of engines with greater power than the standard Continental J-69-T-9 turbojet (920 lb.=417 kg. s.t.) as they became available.

Wide use has been made of new materials such as fiberglas and metal honeycomb, and standard equipment includes ejection seats, liquid oxygen breathing system, edge-lighted instrument panel and hydraulically-operated speed brakes. Fuel system tanks are interconnected to eliminate the need for fuel selection by the pilot.

The engine of the Temco Model 51 can be exposed quickly for maintenance and a complete engine change can be made in 20 minutes. The outer wing panels and rear fuselage are quickly removable. Ground equipment includes an engine dolly which can also be used as a work-stand.

The prototype of the Temco 51 first flew on March 26, 1956 and was sent shortly afterwards to the U.S. Navy base at Patuxent River, Maryland, for evaluation with the Beech Model 73 Jet Mentor.

As a result of these trials, the Navy ordered a batch of 14 Model 51's, under the designation TT-1, for use by the U.S.



The Temco TT-1 Pinto (Continental YJ69 turbojet engine).

Naval Air Training Command to "determine the feasability of beginning a student pilot's flight training in jet-propelled aircraft."

Temco have taken advantage of the design "stretch" of the Model 51 by installing a Continental YJ69-T-25 turbojet (1,025 lb.=465 kg. s.t.) in the prototype, and this aircraft is being evaluated under the company designation of TTX. It is hoped that the TTX will prove capable of all primary and basic training duties, including carrier qualification, with the exception of gunnery which can be taught in modified operational types. Only airframe changes are the installation of an arrester hook, catapult fittings, a larger nose-wheel, additional navigation equipment (TACAN), ground level ejection seats and additional wing tankage.



The Temco TT-1 Pinto Trainer (Continental YJ69 turbojet engine).

TYPE.—Two-seat jet Primary Trainer.

WINGS.—Mid-wing cantilever monoplane. Three different wing sections are used to preserve airflow over the outer wings long after the roots have stalled, to maintain aileron control well into the stall. Wing-tips are of moulded fiberglas. Some wing panels and the landing gear doors are of metal honeycomb construction. Hydraulically-operated flaps. Aileron area: 10.04 sq. ft. (0.93 m.²). Flap area: 15.65 sq. ft. (1.45 m.²). Gross wing area 150 sq. ft. (13.9 m.²).

FUSELAGE.—All-metal forward structure, with moulded fiberglas tail-cone. Engine intake ducts of fiberglas. Large access door in top of nose section. Air brakes at the tail comprise two panels which open out above the tailplane and a third panel which opens downward below it.

TAIL UNIT.—Cantilever monoplane type. All-metal except for fiberglas tailplane tips and fin tip. Areas: fin 23.5 sq. ft. (2.18 m.²), rudder 5.15 sq. ft. (0.48 m.²), tailplane 39 sq. ft. (3.62 m.²), elevator 11.6 sq. ft. (1.08 m.²). Tailplane span 13 ft. 3 in. (4.85 m.).

LANDING GEAR.—Retractable tricycle type. Hydraulic retraction. All units designed to extend and lock under gravity in the event of complete hydraulic failure. Wide track main units, stressed for an ultimate sinking speed of 20.4 ft./sec. (6.1 m./sec.). Oversize tyres and brakes. Wheel track 13 ft. 3¼ in. (4.87 m.).

POWER PLANT.—One Continental YJ69-T-9 turbojet engine supplying 920 lb. (417 kg.) s.t. at sea level. Normal fuel capacity 124 U.S. gallons (468 litres).

ACCOMMODATION.—Pupil and instructor in tandem in enclosed cabin, with raised rear seat. Dual controls and instruments. Air conditioning. Ejection seats. All primary flight controls are mechanical push-rod type. Electrically-actuated trim-tabs.

DIMENSIONS.—
Span 29 ft. 10 in. (9.09 m.).
Length 30 ft. 7 in. (9.33 m.).
Height 10 ft. 10 in. (3.30 m.).

WEIGHT.—
Normal weight loaded 4,400 lb. (1,996 kg.).

PERFORMANCE (TT-1).—
Max. speed at 15,000 ft. (4,570 m.) 345 m.p.h. (556 km.h.).
Max. speed at S/L. 328 m.p.h. (528 km.h.).
Max. diving speed 518 m.p.h. (834 km.h.).
Cruising speed at 25,000 ft. (7,620 m.) 270 m.p.h. (435 km.h.).
Stalling speed at landing weight 69 m.p.h. (111 km.h.).
Stalling speed at take-off weight 76 m.p.h. (122 km.h.).
Rate of climb at S/L. 1,900 ft./min. (580 m./min.).
Service ceiling 32,200 ft. (9,815 m.).
Take-off distance to 50 ft. (15.25 m.) 2,995 ft. (913 m.).
Endurance at S/L 1.5 hours.

PERFORMANCE (TTX, estimated).—
Max. speed at 15,000 ft. (4,570 m.) 363 m.p.h. (584 km.h.).
Rate of climb at S/L 2,090 ft./min. (637 m./min.).
Service ceiling 35,200 ft. (10,730 m.).
Take-off distance to 50 ft. (15.25 m.) 2,513 ft. (766 m.).



The Temco XKDT-1 Teal Expendable Rocket-powered Target Drone.

THE TEMCO TEAL TARGET DRONE.
U.S. Navy Designation: XKDT-1.

The XKDT-1 is a small rocket-propelled expendable target capable of a speed of Mach 0.95 at 50,000 ft. (15,250 m.) or above. It won a U.S. Navy design competition, as a result of which Temco were awarded a contract for the design, construction and flight testing of an evaluation quantity of the drones, together with launchers, check-out and handling equipment.

Intended primarily for training jet pilots and for missile evaluation, the XKDT-1 is about 12 ft. (3.66 m.) long with a span of 4 ft. 10¾ in. (1.49 m.) and fuselage diameter of 10 in. (0.25 m.). It has one vertical fin on the underside and two on top of the fuselage, so arranged that the target can be launched from beneath piloted aircraft. The fuselage is made of aluminium and magnesium. The sweptback wings have a honeycomb core, and the tail surfaces are machined extrusions. It is powered by a Phillips solid-propellent rocket motor.

The XKDT-1 has a self-contained guidance system; and once launched maintains a constant course and altitude during its powered flight of more than eight minutes. Visual tracking of the target is made possible by ejecting flares from it intermittently during the powered phase of its flight.

Late in 1957 and early in 1958, the XKDT-1 underwent a successful flight test programme at the U.S. Navy's Missile Test Center, Point Mugu, California.

TEXAS A. & M. COLLEGE

AIRCRAFT RESEARCH CENTER, AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS.

ADDRESS: COLLEGE STATION, TEXAS.

A programme of research on agricultural aviation problems is being undertaken at the Aircraft Research Center of the A. and M. College of Texas. This programme, which was initiated by the National Flying Farmers Association, in co-operation with the Civil Aeronautics Administration, the Department of Agriculture and the A. and M. College of Texas, includes the development of aircraft specifically designed for dusting, spraying, seeding and fertilising, and improved dispersing equipment.

An aircraft was designed and built under a C.A.A. contract which became effective on December 7, 1949, and this aircraft, the Ag-1, made its first flight on December 1, 1950.

A modification of the Ag-1, designated the Ag-2, has been developed for commercial production by the Transland Company, of Torrance, California (which see).

In the meantime the Aircraft Research Center has developed a smaller aircraft, the Ag-3. This was sponsored by Piper Aircraft Corporation and the prototype is being evaluated at Piper's new Development Center in Vero Beach, Florida.

THE Ag-3.

The Ag-3 is an experimental aircraft which has been designed to carry a spray or dust load of 800 lb. (365 kg.) with a 135 h.p. engine. It makes use of a number of standard Piper parts. The prototype made its first flight in November, 1954.

TYPE.—Single-seat Experimental Agricultural monoplane.

WINGS.—Low-wing rigidly-braced monoplane. U.S.A. 35B wing section. Chord 5 ft. 3 in. (1.60 m.). Dihedral 6°. Incidence 2°. Metal two-spar frame with fabric covering. Total aileron area 16 sq. ft. (1.48 m.²). Gross wing area 183 sq. ft. (17.0 m.²).

FUSELAGE.—Steel tube fabric-covered structure. Removable panels on whole underside and forward portion of sides.

TAIL UNIT.—Welded steel tube framework covered with fabric. Areas: fin 4 sq. ft. (0.37 m.²), rudder 7.4 sq. ft. (0.69 m.²), tailplane 17 sq. ft. (1.58 m.²), elevators 13 sq. ft. (1.21 m.²). Span of tail 10 ft. 6 in. (3.20 m.).

LANDING GEAR.—Fixed tail-wheel type with provision for conversion to tricycle type. Oleo and rubber cord springing. Wheels, tyres and brakes same as for Piper PA-20 Pacer. Track 6 ft. 10 in. (2.07 m.²).

POWER PLANT.—One 135 h.p. Lycoming O-290 four-cylinder horizontally-opposed air-cooled engine. Sensenich one-piece metal airscrew. Fuel tank (40 U.S. gallons = 151 litres) in fuselage.

ACCOMMODATION.—Single cockpit may be either closed or open. Decking forward of cockpit slopes steeply to ensure good forward view. Headrest forms a turnover structure and guide tubes from windscreen to headrest and cable from headrest to top of fin are provided for protection against cables or wires contacted in flight. 18 cub. ft. (0.51 m.³) hopper for 800 lb. (365 kg.) load of chemical, etc. in front of cockpit, with an adjustable sliding gate and distributor beneath fuselage. Engine-driven pump delivers liquid through manifolds to outlet nozzles.

DIMENSIONS.—
Span 36 ft. 2 in. (11.03 m.).
Length 23 ft. 7 in. (7.19 m.).
Height 6 ft. 10 in. (1.88 m.).

WEIGHTS.—
Weight empty 1,035 lb. (470 kg.).
Weight loaded 2,300 lb. (1,044 kg.).

PERFORMANCE.—
Max. speed 124 m.p.h. (198 km.h.).
Take-off to clear 50 ft. (15.25 m.) with full hopper load and 10 U.S. gallons (37.8 litres) of fuel (zero wind) 920 ft. (281 m.). (Corrected to standard S/L. air).

THOMPSON

CARL THOMPSON.

ADDRESS: SUFFERN, NEW YORK.

Mr. Carl Thompson, a Captain with Eastern Air Lines, has built several light aircraft at his farm in Suffern, New York. Best-known was his second design, the "Screaming Meany," a Goodyear-type racing aircraft that was made from parts of his first home-built aircraft. It was succeeded by a further racing monoplane named "Poncho," which proved too tricky for competition flying. The forward fuselage of this aircraft has been incorporated in Mr. Thompson's latest design, the fully-aerobatic "Mighty Mite," of which a description follows.

THE THOMPSON MIGHTY MITE.

TYPE.—Single-seat Light monoplane.

WINGS.—Braced high-wing monoplane, with single streamlined bracing strut each side. Modified NACA wing section. Chord 5 ft. (1.52 m.). All-metal single-spar structure with metal skin. Full-span ailerons. Plywood wing-tip end-plates to improve stability.

FUSELAGE.—Forward portion of steel-tube construction, covered with metal. Metal semi-monocoque tail-cone.

TAIL UNIT.—Cantilever monoplane type. End-plates on tailplane. Trim-tabs on elevators. Foam rubber seal between tailplane and elevators.

LANDING GEAR.—Non-retractable tail-wheel type. Main units have cantilever spring-steel legs, Goodyear tyres and hydraulic brakes. Steerable tail-wheel.

POWER PLANT.—One 85 h.p. Continental C85 four-cylinder horizontally-opposed air-cooled engine, driving wooden two-blade Beech-Roby controllable-pitch airscrew. Fuel in one tank in wing and one in fuselage, with total capacity of 15 U.S. gallons (56.8 litres).

ACCOMMODATION.—Single seat in enclosed cabin, with entrance via upward and downward hingeing panels on starboard side. Full range of cockpit instruments. Mitchell Airboy Senior radio.

DIMENSIONS.—
Span 16 ft. (4.88 m.).
Length 17 ft. (5.18 m.).

PERFORMANCE.—
Max. speed 165 m.p.h. (266 km.h.).
Cruising speed 150 m.p.h. (240 km.h.).
Landing speed 50 m.p.h. (80.5 km.h.).
Rate of climb at S/L 3,000 ft./min. (915 m./min.).
Take-off distance 300-400 ft. (91-122 m.).
Duration approx. 2½ hours.



The Thompson Mighty Mite (85 h.p. Continental C85 engine).

TRANSLAND

TRANSLAND AIRCRAFT, DIVISION OF HI-SHEAR RIVET TOOL COMPANY.

HEAD OFFICE AND WORKS: 2600 W. 247TH STREET, TORRANCE, CALIFORNIA.

President: George S. Wing.

Chief Engineer: Fred Thearle.

Transland Aircraft, a division of the Hi-Shear Rivet Tool Company of Los Angeles, California, has for several years been a leading manufacturer of equipment to convert surplus trainers into crop-dusting aircraft. It is now undertaking the manufacture of complete aircraft for agricultural use, its first aircraft being the Ag-2.

The Ag-2 was designed round the applicating equipment of proven Transland design. It is intended for use not only over cultivated fields but also for fire fighting (with water and fire retardant chemicals), the treatment of infested forests, the restoration of range lands by application of top dressings and the control of noxious plants.

The first prototype Ag-2 flew for the first time on October 11, 1956, with a 450 h.p. Pratt & Whitney R-985 engine, and was re-engined in the Spring of 1957 with a 600 h.p. Pratt & Whitney R-1340 engine.

It was hoped to complete tests for C.A.A. Certification in the Spring of 1958, and then to begin delivery of the Ag-2 to customers.

THE TRANSLAND Ag-2.

TYPE.—Single-seat Agricultural monoplane.

WINGS.—Low-wing cantilever monoplane. NACA 64021 high-lift wing section. Aspect ratio 5.19 (flaps up), 5.44 (flaps down). Chord 7 ft. 10.4 in. (2.40 m.) (flaps up). Dihedral 0° (centre-section), 12° (outer panels). Incidence 4°. All-metal structure of riveted 24ST aluminium-alloy. Full-span slotted flaps, the outer wing flaps with slot lips serving as ailerons. When flaps are lowered the elevators are automatically trimmed. Total area of flaps 31.4 sq. ft. (2.92 m.²). Total area of ailerons 44.8 sq. ft. (4.16 m.²). Gross wing area 321.6 sq. ft. (29.87 m.²).

FUSELAGE. — All-metal semi-monocoque structure of riveted 24ST aluminium-alloy. All internal structure is zinc-chromate primed or otherwise protected with finishes impervious to corrosive agricultural chemicals.

TAIL UNIT.—Cantilever monoplane type. All-metal construction. Areas: fin 10.36 sq. ft. (0.96 m.²), rudder 11.27 sq. ft. (1.05 m.²), tailplane 30.59 sq. ft. (2.84 m.²), elevators 26.28 sq. ft. (2.44 m.²). Tailplane span 15 ft. 2 in. (4.62 m.).

LANDING GEAR.—Fixed tail-wheel type. Vultee 51045 air/oil shock-struts. Goodrich wheels and 27SC Type 1 smooth-contour tyres. Hayes hydraulic drum-type brakes. Goodrich low-pressure tail-wheel tyre. Wire cutting blades attached to shock struts. Track 10 ft. 10 in. (3.3 m.).

POWER PLANT.—One 600 h.p. Pratt & Whitney R-1340 S3H1 or AN-1 Wasp radial air-cooled engine. Hamilton Standard 6101A two-blade, constant-speed airscrew 9 ft. (2.74 m.) diameter. Cell-type fuel tank (62.5 U.S. gallons = 236 litres) in each outer wing. Oil capacity 10 U.S. gallons (37.9 litres).

ACCOMMODATION.—Pilot's cockpit over trailing-edge of wing. Pilot's seat and shoulder harness stressed to take 40G load. Sliding canopy normally fitted; but open cockpit optional. "Jump seat" for one person behind pilot. Similar seats for two more passengers can be installed in hopper. Cockpit sealed to prevent dust or liquid penetration.

EQUIPMENT.—Dust hopper (53 cub. ft. = 1.5 m.³) an integral part of fuselage forward of cockpit. Two non-corrosive plastic spray tanks (62.5 U.S. gallons = 236 litres each) in each inner wing. Dust dispersal through rotary gate in underside of fuselage, pattern and swath width being controlled by adjustable vanes. Spray system operated by engine-driven pump through non-corrosive external piping and spray nozzles along wing trailing-edge. Drive for dust gate agitator and spray pump taken from gear-box on engine starter pad. Simple clutch system enables pilot to actuate either dust or spray system and either system controlled by single lever.



The Transland Ag-2 (600 h.p. Pratt & Whitney R-1340 engine).

DIMENSIONS.—
Span 42 ft. (12.8 m.).
Length 28 ft. 5 in. (8.66 m.).
Height 9 ft. 8 in. (2.95 m.).

WEIGHTS.—
Weight empty 3,400 lb. (1,542 kg.).
Payload 2,000 lb. (907 kg.).
Weight loaded 6,000 lb. (2,724 kg.).
Wing loading 18.6 lb./sq. ft. (90.8 kg./m.²).
Power loading 10 lb./h.p. (4.5 kg./h.p.).

PERFORMANCE (at 3,883 lb. = 1,761 kg. A.U.W.).
Cruising speed (64% power) 126 m.p.h. (203 km.h.).
Cruising speed (50% power) 117 m.p.h. (188 km.h.).
Stalling speed (flaps up) 62 m.p.h. (100 km.h.).
Stalling speed (flaps down) 51 m.p.h. (82 km.h.).
Rate of climb at S/L 1,800 ft./min. (550 m./min.).
Take-off run, zero wind 175 ft. (53 m.).
Take-off distance to 50 ft. (15.25 m.) 325 ft. (99 m.)
Landing run 250 ft. (76 m.).



The Transland Ag-2 (600 h.p. Pratt & Whitney R-1340 engine).

PERFORMANCE (at 6,000 lb.=2,724 kg. A.U.W.).—
Cruising speed (64% power) 120 m.p.h. (193 km.h.).
Cruising speed (50% power) 105 m.p.h. (169 km.h.).
Stalling speed (flaps up) 77 m.p.h. (124 km.h.).
Stalling speed (flaps down) 61 m.p.h. (98 km.h.).
Rate of climb at S/L 950 ft./min. (290 m./min.).
Take-off run, zero wind 450 ft. (137 m.).
Take-off distance to 50 ft. (15.25 m.) 700 ft. (213 m.).

TRECKER

TRECKER AIRCRAFT CORPORATION.

HEAD OFFICE AND WORKS: GENERAL MITCHELL FIELD, MILWAUKEE, WISCONSIN.

President: Francis J. Trecker.

Executive Vice-President: Carl B. Wootten.

Trecker Aircraft Corporation was formed as a division of the Kearney & Trecker Corporation, to assemble and distribute the Italian Piaggio P.136 twin-engined amphibian, under the name of Trecker Gull. The first aircraft of this type was assembled by Trecker in 1955.

THE TRECKER GULL.

Gull is the name under which the Piaggio P.136 is sold by the Trecker company, in two versions as follows:—

Gull. This is the standard version with two 270 h.p. Lycoming GO-480 B1B engines, corresponding with the Piaggio P.136-L-1.

Super Gull. With 340 h.p. Lycoming GSO-480-A1A6 supercharged engines. Corresponding with the Piaggio P.136-L-2.



The Trecker Gull, which is the Italian Piaggio P.136 built under licence.

In each case, the hulls and wings are fabricated in Italy and shipped to Trecker's Milwaukee factory, where they are assembled with all American components, including Lycoming engines, Hartzell airscrews, tyres, wheels, radio and instruments.

Full details of the P.136 will be found under "Piaggio" in the Italian section of this work.

VERTOL

VERTOL AIRCRAFT CORPORATION.

HEAD OFFICE AND WORKS: MORTON, PENNSYLVANIA.

Chairman and President: Don. R. Berlin.

Vice-President: Felix A. Kalinski.

Vice-President, International Division: Harry S. Pack.

Vice-President: Wesley R. Frysztacki.

Vice-President, Engineering: L. L. Douglas.

Vice-President, Manufacturing: William Davey.

Vice-President and Treasurer: Gareth W. Speer.

Treasurer: H. W. Lord.

Secretary: J. A. O'Hara.

Director of Procurement: Lewis Sinning.

Director, Government Operations: James N. Davis.

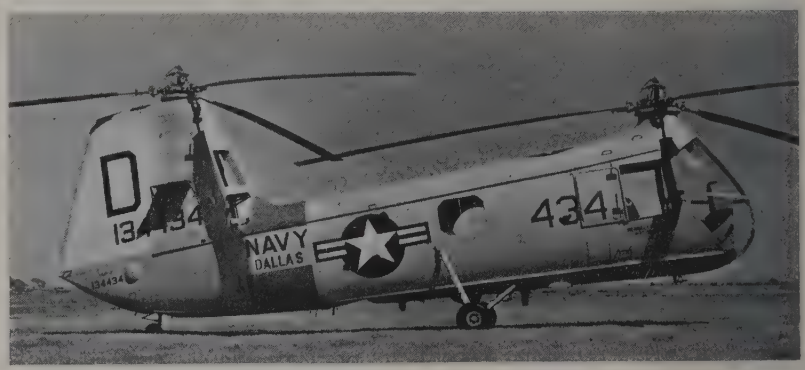
Assistant to President for Public Relations: Edward J. Doherty.

The Vertol Aircraft Corporation was, prior to March, 1956, known as the Piasecki Helicopter Corporation and except for certain changes in management it continues the activities of the former company.

It has a wholly-owned subsidiary known as Vertol Aircraft Company (Canada) Ltd at the former R.C.A.F. station on the outskirts of Arnprior, Ontario, where overhaul and servicing of R.C.A.F. H-21 and R.C.N. HUP helicopters is undertaken.

The Canadian company has also developed a modified version of the H-21, known as the Vertol 42, and a full description of this appears in the entry for Vertol Aircraft Company (Canada) Ltd.

Another wholly-owned subsidiary is Allied Research Associates, Inc., of Boston, which is engaged on studies in a range of subjects including space flight and nuclear weapons.



The Vertol HUP-2 Retriever (550 h.p. Continental R-975 engine). (*Gordon Williams*).

THE VERTOL RETRIEVER AND ARMY MULE.

U.S. Navy designation: HUP Retriever.
U.S. Army designation: H-25A Army Mule.

This single-engined tandem-rotored helicopter was designed to meet the requirements of the U.S. Navy for ship-board operation, including carrier plane guard duty, rescue, observation and inter-ship and ship-to-shore utility transport duties. It was required to negotiate the smallest aircraft-carrier lift without blade folding and to go down a standard cruiser aircraft lift with blades folded.

The HUP helicopter has an all-metal soundproofed fuselage with a normal accommodation for a crew of two and four passengers or three stretcher cases. A large loading door and ample cabin dimensions also permit the transport of a wide variety of high or low density cargo. An internally-operated rescue hatch adjacent to the pilot's seat is large enough to allow the passage of a loaded stretcher. A hydraulically-operated hoist above the hatch is used for hoisting survivors while hovering, and if a rescue



The Vertol H-21B Helicopter (1,425 h.p. Wright R-1820 engine). (*Gordon Williams*).

sling is used the pilot can conduct the entire loading operation without assistance.

The 339th and last HUP was delivered to the U.S. Navy in July, 1954. Others are in service with the Royal Canadian Navy, and French Navy, while the U.S. Army uses the same basic design as the H-25A. The several versions of this helicopter which are in service are identified below.

HUP-1. 525 h.p. Continental R-975-34 engine. First production model. Deliveries started in 1950 and were completed in 1952.

HUP-2. 550 h.p. Continental R-975-46 engine. As the result of successful trials in automatic control in all flight conditions with the prototype XHJP-1, using a modified Sperry automatic pilot, all production HUP-2's have an auto-pilot as primary controller. This permits the elimination of the tail stabilising surfaces used in the HUP-1. Fitted with submarine-hunting sonar equipment, the HUP-2S was the first interim anti-submarine warfare helicopter to go into service. HUP-2 also used for plane guard, rescue and utility duties. Deliveries began in 1952 and were completed in 1954.

HUP-3. Medical evacuation and light cargo helicopter. U.S. Navy version of the Army H-25A.

H-25A. U.S. Army version of HUP-type. Incorporates hydraulic boost on all controls, strengthened all-metal cabin floor with cargo tie-down fittings and special modifications to facilitate loading and unloading of stretcher patients. Deliveries began in 1953 and were completed in 1954.

During 1957, the Edo Corporation designed, equipped and tested an amphibious version of the HUP-2. Under a U.S. Navy contract, Edo reinforced and made watertight the bottom of the fuselage, fitted metal outrigger floats on each side of the fuselage and re-ducted the engine cooling system. In initial tests, the modified aircraft was landed at a forward speed of 35 m.p.h. (55 km.h.) in 18 in. (.45 m.) waves and taxied at 17 m.p.h. (27 km.h.), showing excellent manoeuvrability on water.

The following data specifically concerns the HUP-2 and H-25A.

DIMENSIONS.—
Length (rotors turning) 56 ft. 11 in. (17.3 m.).
Length of fuselage (blades folded) 32 ft. (9.75 m.).
Width (rotors turning) 35 ft. (10.7 m.).
Width (blades folded) 12 ft. 11 in. (3.91 m.).
Height (HUP-2) 13 ft. 2 in. (4.0 m.).
Height (H-25A) 12 ft. 6 in. (3.8 m.).

WEIGHTS.—
Empty (HUP-2) 4,132 lb. (1,874 kg.).
Empty (H-25A) 3,928 lb. (1,782 kg.).
Normal loaded weight 5,750 lb. (2,608 kg.).
Max. overloaded weight 6,100 lb. (2,767 kg.).

PERFORMANCE.—
Max. speed at S/L. (normal power) over 105 m.p.h. (170 km.h.).
Cruising speed over 80 m.p.h. (130 km.h.).
Best rate of climb (normal power) 1,000 ft./min. (305 m./min.).
Vertical rate of climb (take-off power) 650 ft./min. (198 m./min.).
Service ceiling over 10,000 ft. (3,050 m.).
Max. range approx. 340 miles (630 km.).

THE VERTOL WORK HORSE.
U.S.A.F. and Army designation: H-21 Shawnee.

The H-21 Work Horse has been supplied to the U.S.A.F., U.S. Army, French Navy, Royal Canadian Air Force and the West German defence force. The German order was for 26 aircraft for which overhaul and repairs will be undertaken by the Weser company, which also holds an option to build the H-21 under licence. The H-21 exists in the following versions :—

YH-21 and H-21A. One Wright R-1820-103 engine with power limited to 1,150 h.p. Arctic rescue helicopter. Passenger-cargo compartment 20 ft. (6.08 m.) long, 5 ft. 8 in. (1.72 m.) wide and 5 ft. 6 in. (1.67 m.) high. Crew of two, pilot and co-pilot (or medical attendant), and accommodation for twelve stretchers or fourteen troops. 400 lb. (182 kg.) capacity swinging boom-type hydraulic hoist above large sliding door immediately behind pilot on starboard side for transferring loads while hovering, and further door on port side aft for loading and unloading on gound. Each wheel of landing-gear can be surrounded with inflatable ring floats to permit landing on water, marsh and land. Equipment includes cabin insulation and heating, blind-flying instruments, hydraulic control boost, external cargo sling, pilot-controlled searchlight, fixed landing light, tie-down cargo fittings in cabin floor, troop seats and stretcher supports. The Arctic Rescue version of the H-21 has



The Vertol H-21D Helicopter, which is an H-21C fitted with two General Electric T58 shaft-turbines.



The Vertol Model 44B Commercial Helicopter with watertight lower fuselage and rubberised-fabric floats.

demonstrated its ability to operate at temperatures down to minus 65°F.

H-21B and H-21C. One 1,425 h.p. Wright R-1820-103 engine. Troop and cargo transport capable of performing assault airlift, transport of troops and equipment, and rescue and evacuation missions for U.S. Air Force and Army. Interior and exterior dimensions and crew accommodations same as for H-21A. Cabin accommodates twelve stretchers or twenty troops. Forward door and swinging boom hoist as for H-21A but rear door larger and two extra windows added. Equipment same as for H-21A except for additional items which include autopilot, provision for jettisonable auxiliary fuel tanks, bullet-sealing fuel and oil tanks, readily-removable armour kit for protection of vital components, etc.

In August, 1957, an H-21C set up a closed circuit distance record for helicopters of 1,199.07 miles (1,929.7 km.), for which it was fitted with three additional 300 U.S. gallon (1,136 litre) fuel tanks in its cargo compartment. Another H-21C in the same month made a non-stop flight of 2,610 miles (4,200 km.) from San Diego to Washington, during which it was refuelled in flight four times by a U-1A Otter tanker aircraft, using the looped hose technique, and twice by taking on fuel whilst hovering over a ground tanker. Intended to prove the practicability of ferrying helicopters over long distances, the flight took 31 hours 40 minutes.

H-21D. An H-21C aircraft has been fitted with two General Electric T58 gas-turbine engines in place of a single R-1820 piston-engine, under a U.S. Navy/Army contract. Both turbines are mounted aft in such a way that the failure of one will not affect the operation of the other. Their greater power and lighter weight give the H-21D a 40% greater payload than piston-engined versions of the H-21, together with a cruising speed of up to 150 m.p.h. (240 km.h.) and much higher hovering ceiling. The H-21D flew for the first time in September, 1957.

DIMENSIONS.—
Rotor diameter 44 ft. (13.42 m.).
Overall length (rotors turning) 86 ft. 4 in. (26.24 m.).
Width (blades folded) 14 ft. 4 in. (4.31 m.).
Overall height 15 ft. 5 in. (4.68 m.).

THE VERTOL MODEL 42.

The Model 42 is a new version of the H-21, developed by Vertol Aircraft Company (Canada) Ltd. and described in that company's entry in the Canadian section of this work. The Model 42 is not produced by the parent company.

THE VERTOL MODEL 44.

The Vertol Model 44 is an improved version of the H-21 and is available in three versions.

Model 44A. Utility passenger/cargo transport with fabric seats, and without the sound-proofing, air inlets, reading lights, etc. of Model 44B. Accommodation for 19 civilian or 20 military passengers, or 12 litters and two attendants. Bulky items can be carried externally on 2½-ton cargo sling.

Model 44B. Commercial passenger transport. Seats 15 (or 14 with toilets) in airliner type cabin, with carry-on luggage space and 45 cub. ft. (1.27 m.³) mail and cargo compartment.

Model 44C. Executive transport version with custom-designed interior. Prototype is fitted out as an office, with five swivelling armchairs, a three-seat lounge, desk and chair, toilet, radio and attendant's seat.

The Model 44 received its CAA Approved Type Certificate in April, 1957. Sales include two Model 44B's to the French Government, four for anti-submarine and other duties with the Swedish Navy, five Model 44B's for New York Airways, and three for the R.C.A.F., which are being operated by Spartan Air Services for supply duties along the Mid-Canada early-warning radar chain.

The R.C.A.F. Model 44's are equipped with new steel-spar metal rotor blades and special stability devices which enable them to operate in heavy rain and poor visibility.

The New York Airways and Swedish Model 44B's have a water-tight lower fuselage and three rubberised-fabric floats, mounted above the wheels of their landing gear, to permit emergency alighting and take-off from water. Touch-down on the water can be made safely at forward speeds up to 30 m.p.h. (48 km.h.), and the helicopter can taxi through the water at up to 10 m.p.h. (16 km.h.).

TYPE.—Tandem-rotor Helicopter.

ROTOR SYSTEM.—Two three-blade rotors, one above flight deck and other at tip of upswept tail. Distance between hub centres 42 ft. 4 in. (12.90 m.).

ROTOR DRIVE.—By shafts, through a friction-and-jaw clutch mechanism in a central



The Vertol Model 44B making a vertical take-off from water.



The Vertol Model 105, which is the Model 44 or H-21 powered by two Lycoming T53 shaft-turbines.

gearbox, from single engine mounted behind main cabin. Provision for full auto-rotation. Overall gearbox reduction ratio approximately 10 : 1.

FUSELAGE.—Metal semi-monocoque structure.

LANDING GEAR.—Non-retractable tricycle type. Wheel track 14 ft. 4 in. (4.37 m.). Wheelbase 24 ft. 6 in. (7.47 m.). Provision for pontoon landing gear.

POWER PLANT.—One Wright Cyclone 977C9 HD1 nine-cylinder radial air-cooled engine, developing 1,425 h.p. at 2,700 r.p.m. at 2,000 ft. (610 m.) for one minute and with a maximum cruising output of 900 h.p. at 2,400-2,500 r.p.m. Provision for fitting two shaft-turbine engines later. Normal fuel capacity 300 U.S. gallons (1,136 litres). Oil capacity 12 U.S. gallons (45.5 litres).

ACCOMMODATION.—Crew of two in forward compartment, with dual controls. Flight deck and main cabin provided with sound-proofing, heating and ventilation. Cabin arrangements as detailed above under individual Models. Maximum cabin dimensions: length 20 ft. (6.10 m.), width 5 ft. 8 in. (1.73 m.), height 5 ft. 6 in. (1.68 m.). Cabin volume approximately 600 cub. ft. (17 m.³). Door at each end of cabin. Rear door has built-in passenger steps and handrail. Larger oval windows on Model 44B.

DIMENSIONS.—
Rotor diameter (each) 44 ft. 0 in. (13.41 m.).
Overall length 86 ft. 4 in. (26.3 m.).
Fuselage length 52 ft. 6 in. (16.0 m.).
Overall height 15 ft. 5 in. (4.70 m.).

WEIGHTS.—
Weight empty 8,990 lb. (4,078 kg.).
Weight loaded (civil) 14,350 lb. (6,509 kg.).
Weight loaded (military) 15,000 lb. (6,805 kg.).

PERFORMANCE (at 14,350 lb. (6,509 kg.) A.U.W.).—
Max. speed at S/L 127 m.p.h. (204 km.h.).
Cruising speed 101 m.p.h. (163 km.h.).
Max. rate of climb at S/L 1,050 ft./min. (320 m./min.).
Hovering ceiling in ground effect 5,400 ft. (1,645 m.).
Hovering ceiling out of ground effect 2,900 ft. (885 m.).
Range, with reserves, 280 miles (450 km.).

THE VERTOL MODEL 105.

The Vertol 105 is basically an H-21 in which the standard Wright R-1820 piston-engine has been replaced by two 825 h.p. Lycoming T53 shaft-turbines. The prototype flew for the first time on November 20, 1957.

The engine installation on the Model 105 has been designed as a kit, so that operators of civil or military helicopters of the H-21 type can convert them to turbine power at minimum cost. Only minor modifications to the airframe are necessary, as the twin turbines pick up the existing engine mounting attachments.

Compared with the piston-engined H-21, the Model 105 has a 40% greater payload and a 50 m.p.h. (80 km.h.) higher speed.

THE VERTOL MODEL 107.
U.S. Army designation: YHC-1.

The Model 107 is a twin-turbine-powered twin-rotor transport helicopter which is being developed in both military and civil forms. The U.S. Army has placed an order for ten under the designation YHC-1; seven to be powered by two General Electric T58 engines giving a total of 2,050 s.h.p., and three by two Lycoming T53 engines totalling 1,650 s.h.p.

The Model 107 follows the basic configuration of the HUP series with the rear rotor pylon enlarged to accommodate the two engines side-by-side above the cabin roof-line. The bladder-type fuel tanks are located in external stubs which support the main landing-wheel units.

The fuselage is of a constant cross-section almost throughout its length with, in the military model, a rear loading ramp and a door with a 70-inch overhead clearance for vehicle loading.

The military YHC-1 version will have accommodation for 22 troops on hinged longitudinal troop seats, plus 1 troop commander seated in the flight compartment between and behind the pilot and co-pilot; or 15 stretcher cases plus 2 medical attendants; or various cargo loads ranging from 1½ to 2½ short tons. The commercial version will normally seat 23-25 passengers but will be able to accommodate up to 30 in a high-density version.

The fuselage is designed to be suitable for alighting on or taking off from water.

A prototype, known as the Model 107A, has been flying since April, 1958, as a test vehicle to check design features and to serve as a demonstrator. Production aircraft will be slightly larger than the 107A. The military YHC-1 version will be coming off the production line early in 1959, while the civil version is expected to be ready for delivery in 1961.

The following data refers to the prototype Model 107A :—

DIMENSIONS.—
Rotor dia. (both) 48 ft. 4 in. (14.7 m.).
Overall length (blades folded) 44 ft. 3½ in. (13.5 m.).
Height (over rear rotor) 17 ft. 7½ in. (5.36 m.).

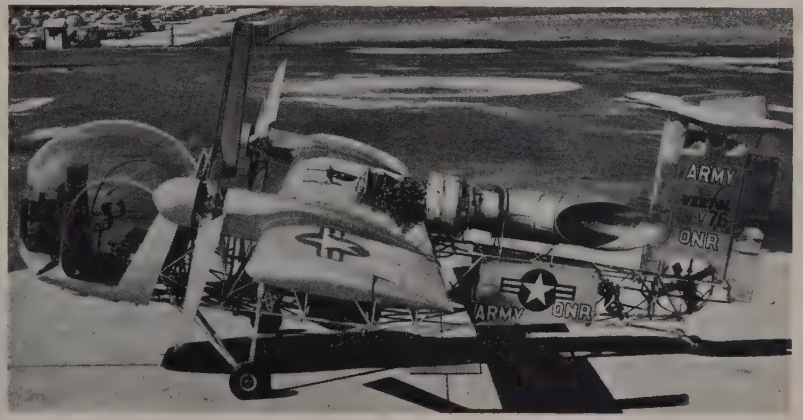
CABIN DIMENSIONS.—
Length 22 ft. 8½ in. (6.92 m.).
Height 5 ft. 10 in. (1.76 m.).
Width 6 ft. 7 in. (2.01 m.).
Volume 795 cub. ft. (22.4 m.³).

WEIGHTS.—
Weight empty (with military equipment) 9,100 lb. (4,132 kg.).
Disposable load 6,450 lb. (2,928 kg.).
Weight loaded 15,550 lb. (7,060 kg.).

PERFORMANCE.—
Max. speed 160 m.p.h. (256 km.h.).

THE VERTOL 76.
U.S. Army designation: VZ-2.

In the Spring of 1956 it was announced that a contract had been awarded to Vertol by the Office of Naval Research and the U.S. Army for the design and development of a turbine-powered tilting-wing vertical take-off and landing (VTOL)



The Vertol Model 76 with its Tilt-wing in the horizontal flight position.

research aircraft, known as the Vertol 76.

This aircraft was completed in April, 1957, when it began an extensive programme of ground and flight testing. This culminated in the announcement on July 23, 1958, that the Vertol 76 had completed successfully transitions from vertical to horizontal flight and *vice versa*.

Vertol have adopted the flying test-bed approach in developing this aircraft, by which means it will be possible to explore the characteristics of the tilting wing with a relatively inexpensive aircraft in considerably less time than is needed to design and construct a prototype.

The Vertol 76 is powered by a single Lycoming T53 turboprop geared to drive two rotor-airscrews mounted on a tiltable wing, and has two ducted fans mounted vertically and horizontally in the tail section to provide additional control. With the wing in the vertical position the rotor-airscrews will provide vertical lift as in a helicopter. For cruising and high speed flight the wing is set in the normal horizontal position with the wing providing the lift and the rotor-airscrews the forward thrust. The transition from vertical lift to forward flight is accomplished by tilting the wing-airscrew combination forward.

In addition, the wing can be set at an angle between the two extremes for short take-off and landing with higher payload than for vertical flight.



The Vertol Model 76 Tilt-wing VTOL Research aircraft taking off vertically.

The announcement of this contract was made only a few months after the expansion of Vertol's research and development activities and their reorganisation into a single Research and Preliminary Design Department under the direction of Lee L. Douglas, Vice-President of Engineering.

DIMENSIONS.—
Span 24 ft. 11 in. (7.60 m.).
Fuselage length 26 ft. 5 in. (8.05 m.).
Wing Chord 5 ft. (1.52 m.).
Rotor-airscrew diameter 9 ft. 6 in. (2.90 m.).

YUGOSLAVIA

GOVERNMENT FACTORIES

The Yugoslav aircraft industry consists essentially of a central national research, design and prototype manufacturing and testing establishment, and a number of purely production factories.

Before the war the Yugoslav aircraft industry was made up of three main firms, Ikarus A.D. with factories at Novi Sad and Zemun; Prva Srpska Fabrika Aeroplana Zivojin Rogojarsky with a factory at Belgrade; and Fabrika Aeroplana i Hidroplana "Zmaj" with a factory at Zemun. All these factories, in addition to building aircraft of various types under licence, including the Potez 25, Hawker Fury, Bristol Blenheim, Dewoitine D.27, Gourdou-Leseurre B.3 and Hanriot training aircraft, produced a variety of types of original design, most of which were illustrated and described in the inter-war editions of "All the World's Aircraft."

During the German occupation all these factories were destroyed and it was not until 1945 that the Ikarus plant at Zemun was sufficiently rebuilt and re-equipped to be able to resume aircraft work. As a nationalised plant it began with the repair and overhaul of YaK-3, YaK-9 and IL-2 Stormovik aircraft belonging to the Sovietised Yugoslav Air Force.

In August, 1946, the remnants of the former Ikarus, Rogojarsky and "Zmaj" companies and their surviving technical stafis were incorporated in the national concern and the design and manufacture of aircraft was resumed.

The first post-war aeroplane of original design was the Aero-2 designed by Engineers Cijan and Petkovic, a two-seat trainer, the prototype of which first flew in October, 1946. This aircraft, which was produced in quantity for the Yugoslav Air Force, was developed through various versions with differing power-plants.

At about the same time the C-3, designed by Cijan and Petkovic, won a competition for a light trainer suitable for use by national flying clubs and schools and was also put into production.

Before the break with the Cominform the only military aircraft built in Yugoslavia were of Russian design. The Ilyushin Il-2 was built in series, and trainer versions of the Il-2 and Yak-3 were also developed and built.

Since the break, however, Yugoslavia has undertaken the design and construction of its own military aircraft. The first example was the S-49, a redesign of the Yak-9 by Sivčev, Zrnic and Popovic. This aircraft has been developed through the S-49A fitted with the Russian VK-105 copy of the Hispano-Suiza 12Y engine, to the S-49C which is powered by the French-built Hispano-Suiza 12Z of greater power.

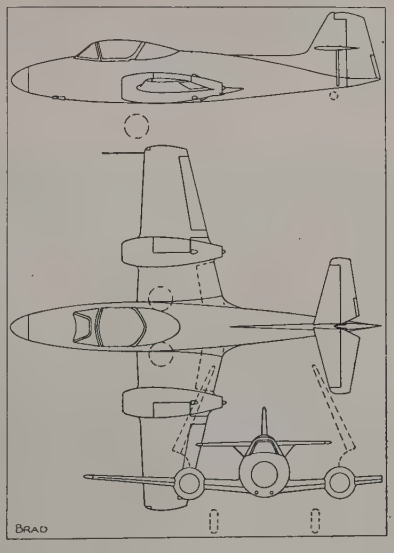
Two other types produced in 1951 were the Type 214 designed by Eng. Prof. Milutinovic and the Type 215, designed by Eng. Stankov, both twin-engined aircraft intended for training and general purpose duties. The former was selected for production for the Air Force as an aircrew trainer.

A 1949 prototype, the Type 213 two-seat advanced trainer, has been modified and fitted with a 600 h.p. Pratt & Whitney Wasp engine, and as the Type 522 has been put into production.

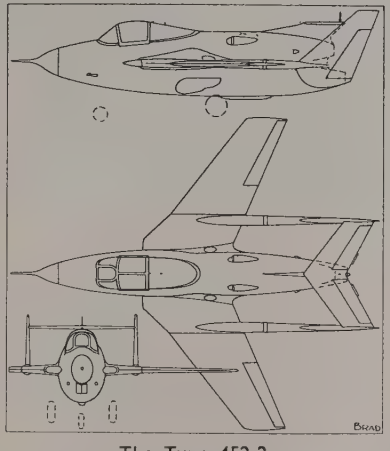
Interesting prototypes built at Zemun, near Belgrade, include the Pionir, a small research monoplane for experiments with a prone pilot position; the Type 451, a larger development of the Pionir; the Type 451-M, which was Yugoslavia's first jet-propelled aircraft; the Type S-451M trainer development; and the Type 452-2 experimental jet aircraft of novel configuration.



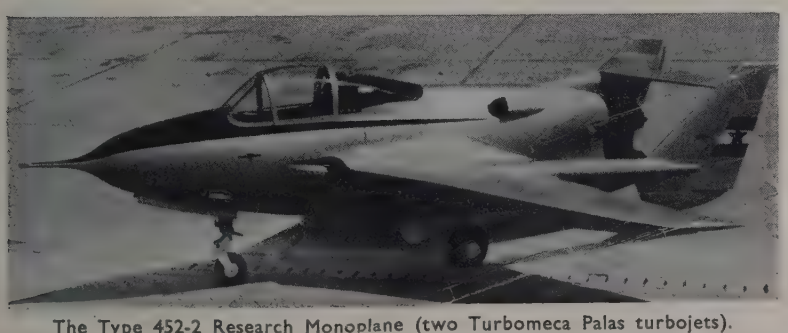
The Type S-451M Trainer (two Turbomeca Palas turbojet engines).



The Type S-451M.



The Type 452-2.



The Type 452-2 Research Monoplane (two Turbomeca Palas turbojets).

THE IKARUS B-12.

The Ikarus B-12 is a single-seat lightweight fighter which has been designed to a Yugoslav Air Force specification. It is powered by a Bristol Orpheus BOr.2 turbojet (2,050 kg.=4,520 lb. s.t.).

THE TYPE S-451M.

TYPE.—Single-seat Jet Trainer.

WINGS.—Low-wing cantilever monoplane. All-metal structure. Centre-section integral with fuselage. Outer wing sections hinged to fold upward.

FUSELAGE.—All-metal semi-monocoque structure in three sections.

TAIL UNIT.—Fin integral with fuselage. Rudder and elevators are statically and aerodynamically balanced. Trim-tabs in elevators.

LANDING GEAR.—Retractable tail-wheel type. Oleo shock-absorbers. Goodyear tyres.

POWER PLANT.—Two Turbomeca Palas turbojet engines (150 kg.=330 lb. s.t. each) mounted at extremities of centre-section. Outer halves of cowlings attached to outer wing sections so that when latter are hinged upward engines are exposed for maintenance or engine change.

ACCOMMODATION.—Single enclosed cockpit in forward fuselage.

DIMENSIONS.—
Span 6.7 m. (21 ft. 7 in.).
Length 6.8 m. (22 ft.).
Height 2.3 m. (7 ft. 7 in.).
Wing area 8.0 m.² (86.08 sq. ft.).

WEIGHT.—
Loaded 1,202 kg. (2,644 lb.).

PERFORMANCE.—
Max. speed 459 km.h. (284.5 m.p.h.).
Min. speed 153 km.h. (94.8 m.p.h.).
Service ceiling 8,550 m. (28,045 ft.).
Range 392 km. (233 miles).
Take-off run 600 m. (656 yds.).
Landing run 582 m. (616 yds.).

THE TYPE 452-2.

The 452-2 is a single-seat research aircraft with swept wings and tail surfaces and is powered by two Turbomeca Palas turbojets mounted one above the other at the rear of the fuselage. The vertical tail surfaces are mounted at the ends of twin booms, with the Vee tailplane in between the fins and supported at its centre by a dorsal fin on the aft end of the fuselage. Separate air inlets are provided for the two engines; in the wing roots for the lower engine and on

the side of the rear fuselage for the upper engine. The landing-gear is a retractable tricycle.

An experimental light alloy is used for the whole structure.

DIMENSIONS.—
Span 5.25 m. (17 ft. 2 in.).
Length 5.97 m. (19 ft. 7 in.).
Height 1.77 m. (5 ft. 9 in.).

LOADED WEIGHT.—
1,100 kg. (2,420 lb.).

PERFORMANCE (Estimated).—
Max. speed 750 km.h. (466 m.p.h.).
Min. speed 190 km.h. (118 m.p.h.).
Duration 75 min.

THE TYPE 522.

TYPE.—Two-seat Advanced Trainer.

WINGS.—Low-wing cantilever monoplane. All-metal two-spar stressed-skin structure.

FUSELAGE.—Oval section all-metal structure in two sections, forward section of a girder type, rear section a semi-monocoque.

TAIL UNIT.—Cantilever monoplane type.

LANDING GEAR.—Tail-wheel type. Main wheels retract forward into fairings at the wing roots. Hydraulic retraction. Hydraulic wheel brakes. Non-retracting tail-wheel.

POWER PLANT.—One 600 h.p. Pratt & Whitney R-1340 AN-1 Wasp nine-cylinder radial air-cooled engine.

ACCOMMODATION.—Tandem seats under a continuous canopy with sliding sections over each cockpit.

ARMAMENT.—Two 7.9 mm. MG-15 machine-guns and four 25 kg. (55 lb.) or four 50 kg. (110 lb.) bombs. There is also provision for two 5-in. HVAR-5 rockets.

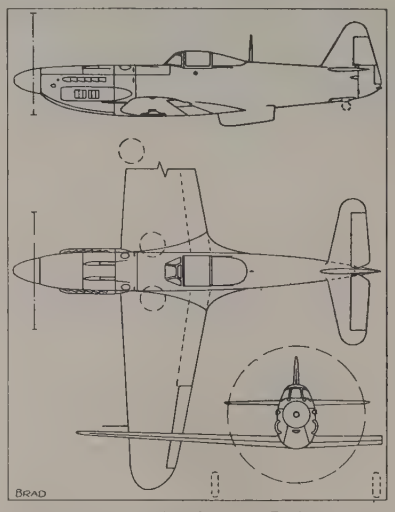
DIMENSIONS.—
Span 11.0 m. (36 ft.).
Length 9.2 m. (30 ft. 2 in.).
Height 3.58 m. (11 ft. 9 in.).

WEIGHT.—
Loaded 2,400 kg. (5,280 lb.).

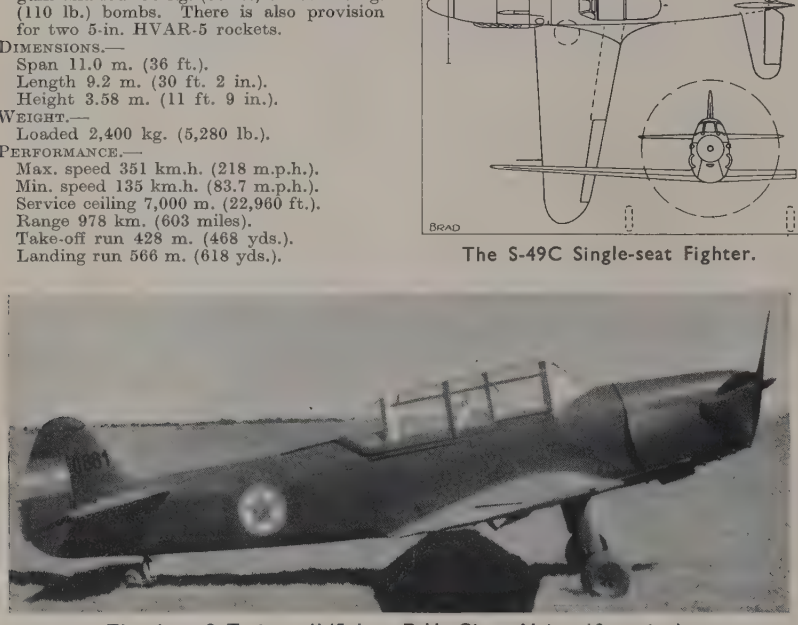
PERFORMANCE.—
Max. speed 351 km.h. (218 m.p.h.).
Min. speed 135 km.h. (83.7 m.p.h.).
Service ceiling 7,000 m. (22,960 ft.).
Range 978 km. (603 miles).
Take-off run 428 m. (468 yds.).
Landing run 566 m. (618 yds.).



The Type 522 Advanced Trainer (600 h.p. Pratt & Whitney R-1340 engine).



The S-49C Single-seat Fighter.



The Aero-2 Trainer (145 h.p. D.H. Gipsy Major 10 engine).

THE S-49C.

TYPE.—Single-seat Fighter.

WINGS.—Low-wing cantilever monoplane. Two-spar all-metal structure.

FUSELAGE.—Welded steel tube structure.

TAIL UNIT.—Cantilever monoplane type.

LANDING GEAR.—Retractable tail-wheel type. Main wheels retract inwardly into wings, tail-wheel backward into fuselage.

POWER PLANT.—One 1,500 h.p. Hispano-Suiza 12Z twelve-cylinder vee liquid-cooled engine driving a three-blade airscrew. Radiator under fuselage aft of wings.

ACCOMMODATION.—Enclosed cockpit with sliding canopy. Bullet-proof windscreen and armour plate protection.

ARMAMENT.—Two 12.7 mm. machine-guns in top cowling and one 20 mm. cannon firing through the airscrew hub.

DIMENSIONS (Approx.).—
Span 9.45 m. (31ft.).
Length 8.5 m. (28 ft.).
Height 2.9 m. (9 ft. 6 in.).

WEIGHT LOADED (Approx.).—
3,400 kg. (7,500 lb.).

PERFORMANCE.—
Max. speed over 620 km.h. (384.5 m.p.h.).
Service ceiling 10,000 m. (32,800 ft.).

THE AERO-2.

TYPE.—Two-seat Primary Trainer or Army Co-operation monoplane.

WINGS.—Low-wing cantilever monoplane. Centre-section integral with fuselage, outer sections detachable. All-wood two-spar plywood-covered structure.

FUSELAGE.—All-wood monocoque structure.

TAIL UNIT.—Cantilever monoplane type. Fin and tailplane are wood-framed with plywood covering, rudder and elevators have wood frames and fabric covering.

LANDING GEAR.—Fixed tail-wheel type. Single-strut cantilever shock struts of Ikarus design. Wheel-brakes. Steerable tail-wheel.

POWER PLANT (sub-types B and BE).—One 145 h.p. D.H. Gipsy Major 10 four-cylinder in-line inverted air-cooled engine.

POWER PLANT (sub-types C, D and F).—One 160 h.p. Walter Minor 6/III six-cylinder in-line inverted air-cooled engine.

ACCOMMODATION.—Tandem cockpits, open in sub-types B, C and F, or beneath transparent canopy with sliding sections over cockpits in sub-types BE and D. Dual controls.

DIMENSIONS.—
Span 10.5 m. (34 ft. 5 in.).
Length 8.45 m. (27 ft. 8½ in.).
Height 2.7 m. (8 ft. 10 in.).

WEIGHT.—
Loaded 996.5 kg. (2,192 lb.).

PERFORMANCE.—
Max. speed 208 km.h. (129 m.p.h.).
Cruising speed 160 km.h. (100 m.p.h.).
Service ceiling 4,500 m. (14,760 ft.).
Range 680 km. (420 miles).

THE AERO-3.

TYPE.—Two-seat Primary Trainer or Army Co-operation monoplane.

WINGS.—Low-wing cantilever monoplane. Structure as for Aero-2.

FUSELAGE.—As for Aero-2.

TAIL UNIT AND LANDING GEAR.—Similar to Aero-2.

POWER PLANT.—One 185 h.p. Lycoming six-cylinder horizontally-opposed air-cooled engine.

ACCOMMODATION.—Tandem cockpits with dual controls beneath one-piece transparent sliding canopy.

DIMENSIONS.—
Same as Aero-2 except :
Length 8.58 m. (28 ft. 1 in.).

WEIGHT.—
Loaded 1,198 kg. (2,646 lb.).

PERFORMANCE.—
Max. speed 230 km.h. (142.6 m.p.h.).
Cruising speed 180 km.h. (112 m.p.h.).
Service ceiling 4,300 m. (14,100 ft.).
Range 680 km. (422 miles).

THE KURIR DM-6R.

TYPE.—Two/three-seat monoplane designed for Army liaison, ambulance duties and parachute training.

WINGS.—High-wing cantilever monoplane. All-metal structure. Electrically-operated high-lift Fowler-type flaps inboard of ailerons. Leading-edge slots ahead of ailerons.

FUSELAGE.—All-metal structure.

TAIL UNIT.—Metal frames with fabric covering. Single bracing strut between tailplane and fin.

LANDING GEAR.—Fixed type of Ikarus construction. Long-stroke oleo shock-absorber struts. Wheel brakes. Wheels can be replaced by skis.



The Aero-3 Trainer (185 h.p. Lycoming engine).

POWER PLANT.—One 155 h.p. DM-6R six-cylinder in-line inverted air-cooled geared engine of Yugoslav design. Engine fitted with air filter for use on primitive air-strips. Two-blade Scinteks constant-speed airscrew of Yugoslav design.
ACCOMMODATION.—Enclosed cabin normally seating two but an optional third seat may be provided. Rear seat or seats removable to provide room for two stretchers. Equipment includes SCR-27HN radio and ADF-12 radio compass.
DIMENSIONS.—
Span 14.9 m. (49 ft.).
Length 9.68 m. (31 ft. 9 in.).
Height 2.5 m. (8 ft. 2½ in.).
WEIGHT.—
Loaded (two-seater) 1,400 kg. (3,080 lb.).
PERFORMANCE.—
Max. speed 189 km.h. (115 m.p.h.).
Cruising speed 160 km.h. (100 m.p.h.).
Min. speed 59.5 km.h. (36.8 m.p.h.).
Service ceiling 3,300 m. (10,825 ft.).
Range 760 km. (470 miles).
Take-off distance to 15 m. (50 ft.) 220 m. (240 yds.).
Landing distance from 15 m. (50 ft.) 100 m. (109 yds.).



The Kurir DM-6R (155 h.p. DM-6R engine).

THE TYPE 214-D.

TYPE.—Twin-engined Bombing and Aircrew Trainer.
WINGS.—Low-wing cantilever monoplane. All-wood two-spar plywood-covered structure. Dihedral outboard of engine nacelles.
FUSELAGE.—Oval section all-wood plywood-covered structure.
TAIL UNIT.—Braced monoplane type with twin fins and rudders. Fixed surfaces have wood frames and plywood covering, movable surfaces have metal frames and are covered with fabric.
LANDING GEAR.—Retractable type. Main wheels retract backwards into engine nacelles, leaving part of wheels projecting. Fixed tail-wheel.
POWER PLANT.—Two 600 h.p. Pratt & Whitney R-1340-AN-1 nine-cylinder radial air-cooled engines.
ACCOMMODATION.—Enclosed cockpit seating two side-by-side over leading-edge of wings. Bomb-aimer's position in nose with observation windows and optically flat aiming panel. Cabin aft of pilot's compartment for navigator, radio-operator or 6-8 pupils.
DIMENSIONS.—
Span 16.2 m. (53 ft. 1½ in.).
Length 11.2 m. (36 ft. 9 in.).
Height 3.95 m. (12 ft. 11 in.).
WEIGHT.—
Weight loaded 5,027 kg. (11,059 lb.).
PERFORMANCE.—
Max. speed 365 km.h. (226 m.p.h.).
Service ceiling 7,000 m. (22,960 ft.).
Range 1,080 km. (670 miles).
Take-off run 300 m. (328 yds.).
Landing run 450 m. (492 yds.).

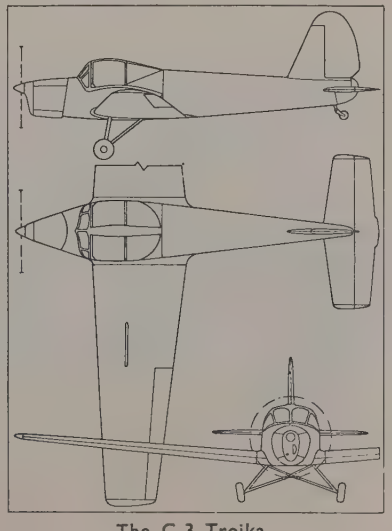


The Type 214-D Bombing and Aircrew Trainer (two 600 h.p. Pratt & Whitney R-1340 engines).

THE Fa-2 AMPHIBIAN.

The Fa-2 was designed by Mr. Fizir to meet the requirements of the Horvat Aviation Association for a small amphibian suitable for passenger work along the Yugoslav coast. To simplify construction by small companies, it is built mainly of wood. The prototype was last reported to be nearing completion in 1955.

TYPE.—Four-seat Amphibian.
WINGS.—Cantilever high-wing monoplane. Aspect ratio 6.5. All-wood two-spar structure. Centre-section is integral with fuselage. Leading-edge plywood-covered. Remainder of wing fabric-covered. Wing area 22 m.² (236.72 sq. ft.).
FUSELAGE.—Two-step hull of wooden construction with plywood covering.
TAIL UNIT.—Cantilever monoplane type with tailplane mid-set on fin to provide water clearance at take-off. Wooden structure. Fin and tailplane plywood-covered. Rudder and elevators fabric-covered.
LANDING GEAR.—Main landing gear units partially-retractable, above water level, when aircraft is afloat. Two fixed floats under wings.
POWER PLANT.—One 195 h.p. Lycoming O-435A six-cylinder horizontally-opposed air-cooled engine driving pusher airscrew.
ACCOMMODATION.—Enclosed cabin for four persons.
DIMENSIONS.—
Span 12.0 m. (39 ft. 4 in.).
Length 8.34 m. (27 ft. 4 in.).
WEIGHTS AND LOADINGS.—
Weight empty 800 kg. (1,760 lb.).
Weight loaded 1,250 kg. (2,750 lb.).
Wing loading 56.8 kg./m.² (11.63 lb./sq. ft.).
Power loading 6.4 kg./h.p. (14.08 lb./h.p.).
PERFORMANCE (estimated).—
Max. speed 205 km.h. (127 m.p.h.).
Cruising speed 175 km.h. (108.5 m.p.h.).
Landing speed 90 km.h. (55.8 m.p.h.).
Ceiling 3,000 m. (9,840 ft.).
Range 550 km. (341 miles).



The C-3 Trojka.

THE C-3 TROJKA (THREE).

TYPE.—Two-seat Light monoplane.
WINGS.—Low-wing cantilever monoplane. Single-spar all-wood structure. Detachable wing-tips. Spoiler-type slatted air-brakes on top surfaces hinge downward into slots aft of main spar when not in use. Wing area 15.5 m.² (166.8 sq. ft.).
FUSELAGE.—All-wood structure in two main portions with joint aft of cabin. Rear fuselage a pure monocoque.
TAIL UNIT.—Cantilever monoplane type. All-wood structure. Single-piece tailplane and elevator. Detachable fin and horn-balanced rudder. Trim-tab in centre of elevator.
LANDING GEAR.—Split type. Two hinged side vees and two half axles with rubber cord springing at inner ends of axles. Swivelling tail-wheel.
POWER PLANT.—One 60 h.p. Walter Mikron II four-cylinder in-line inverted air-cooled engine on steel-tube mounting. Two-blade fixed-pitch airscrew. Fuel tank aft of seats. Oil tank in engine compartment.
ACCOMMODATION.—Enclosed cabin seating two side-by-side with dual controls. Cabin top is divided on fore-and-aft centre-line and each curved side section slides aft for access to both seats.
DIMENSIONS.—
Span 10.5 m. (34 ft. 5 in.).

Length 8.85 m. (29 ft.).
Height 2.10 m. (6 ft. 10 in.).

WEIGHTS AND LOADINGS.—
Weight empty 374.7 kg. (824.3 lb.).
Weight loaded 603.7 kg. (1,328.1 lb.).
Wing loading 39.0 kg./m.² (7.99 lb./sq. ft.).

PERFORMANCE.—
Max. speed 161 km.h. (100 m.p.h.).
Cruising speed 145 km.h. (90 m.p.h.).
Min. speed 73.6 km.h. (45.7 m.p.h.).
Landing speed (with air-brakes) 65 km.h. (40.4 m.p.h.).
Climb to 1,000 m. (3,280 ft.) 10.3 min.
Service ceiling 3,900 m. (12,790 ft.).
Range 590 km. (376 miles).
Take-off run 177 m. (193 yds.).
Landing run (with air-brakes) 215 m. (235 yds.).

THE KB-6 MATAJUR.

The KB-6 Matajur was designed by the Letalski Konstrukcijski Biro, a design group of the High Technical School in Ljubljana. Responsible for the design and its subsequent development are Dusan Cener, Stane Grcar, Natan Bernot and Vital Kovacic.

TYPE.—Two-seat Trainer and Tourer.

WINGS.—Low-wing cantilever monoplane. Aspect ratio 8. Taper ratio 0.5. Dihedral 5° 50'. Wood structure with one main spar. Plywood covering over leading-edge, fabric over remainder. Auxiliary spar carries flaps and statically and aerodynamically balanced ailerons. Flap area 1.42 m.² (15.3 sq. ft.). Total aileron area 1.38 m.² (14.8 sq. ft.). Gross wing area 14.0 m.² (150.7 sq. ft.).

FUSELAGE. — All - wood semi - monocoque structure.



The KB-6 Matajur (136 h.p. Régnier 4L00 engine).

Initial rate of climb 215 m./min. (689 ft./min.).
Service ceiling 4,500 m. (14,800 ft.).
Range 820 km. (510 miles).

THE KB-6 MATAJUR-TRISED.

The Matajur-Trised is a three-seat version of the previously-described model. This version is powered by a 160 h.p. Yugoslav-built Walter Minor JW-6-III six-cylinder inverted air-cooled engine.

DIMENSIONS.—
Same as for KB-6 two-seater.

WEIGHTS AND LOADINGS.—
Weight empty 710 kg. (1,562 lb.).
Weight loaded 1,150 kg. (2,530 lb.).
Wing loading 82.2 kg./m.² (16.63 lb./sq. ft.).
Power loading 7.18 kg./h.p. (15.79 lb./h.p.).



The KB-6 Matajur-Trised (160 h.p. Walter Minor JW-6-III engine).

TAIL UNIT.—Cantilever monoplane type. Fixed surfaces are all wood. Aerodynamically balanced elevators and rudder have wood frames and fabric covering. Starboard elevator has trim-tab controllable from cockpit.

LANDING GEAR.—Fixed tail-wheel type. Spring-oil shock-absorbers. Steerable tail-wheel. Hydraulic wheel brakes. Track 2.5 m. (8 ft. 2 in.).

POWER PLANT.—One 136 h.p. Régnier 4L00 four-cylinder in-line inverted air-cooled engine on steel-tube bearers. Two-blade fixed-pitch wood airscrew, 1.95 m. (6 ft. 5 in.) diameter. Aluminium fuel tank (141 litres = 37.2 Imp. gallons) in fuselage behind seats. Oil tank 9 litres (2.4 Imp. gallons).

ACCOMMODATION.—Enclosed cabin seating two side-by-side with dual controls. Adjustable seats. Baggage compartment aft of seats. Full electrical equipment. Glider towing hook. Touring version has upholstered cabin.

DIMENSIONS —
Span 10.6 m. (34 ft. 9 in.).
Length 8.36 m. (27 ft. 5 in.).
Height 2.15 m. (7 ft. 1 in.).

WEIGHTS AND LOADINGS.—
Weight empty 659 kg. (1,453 lb.).
Crew (2) with parachutes 180 kg. (397 lb.).
Fuel and oil 110 kg. (234 lb.).
Baggage 30 kg. (66 lb.).
Weight loaded 979 kg. (2,159 lb.).
Wing loading 70 kg./m.² (14.3 lb./sq. ft.).
Power loading 7.2 kg./h.p. (15.8 lb./h.p.).

PERFORMANCE.—
Max. speed at S/L. 222 km.h. (138 m.p.h.).
Cruising speed 200 km.h. (124 m.p.h.).
Min. speed with flaps 88 km.h. (55 m.p.h.).

PERFORMANCE.—
Max. speed at S/L. 230 km.h. (143 m.p.h.).
Max. speed at 2,000 m. (6,560 ft.) 220 km.h. (137 m.p.h.).
Cruising speed 180 km.h. (112 m.p.h.).
Min. speed with flaps 90 km.h. (56 m.p.h.).
Rate of climb at S/L. 150 m./min. (492 ft./min.).
Service ceiling 3,500 m. (10,480 ft.).
Range 650 km. (405 miles).
Take-off distance to clear 15 m. (50 ft.) 450 m. (492 yds.).

THE LK-1.

The LK-1 has been built in the Letov aircraft factory at Ljubljana. It was first conceived as a two-seater with a 100 h.p. engine but the design was changed during construction to its present form as a four-seater with a 160 h.p. engine. The prototype first flew on January 5, 1955.

DESIGNER.—Prof. Dr. Eng. A. Kuhelj.

TYPE.—Four-seat Tourer, also suitable for use as an Ambulance, Glider-tug, Agricultural aircraft, etc.

WINGS.—High-wing strut-braced monoplane. NACA 2415 wing section. Two-spar wood structure covered with plywood and fabric. Flaps inboard of ailerons. Ailerons and flaps are of wood with fabric covering. Gross wing area 17.5 m.² (188 sq. ft.).

FUSELAGE.—Welded steel-tube structure covered with fabric.

TAIL UNIT.—Braced monoplane type. Adjustable tailplane. Welded steel-tube framework covered with fabric.

LANDING GEAR.—Fixed split-axle type. Rubber-in-compression springing. Steerable tail-wheel.

POWER PLANT.—One 160 h.p. Yugoslav Walter Minor JW-6-III six-cylinder in-line inverted air-cooled engine. Two-blade fixed-pitch wood airscrew. Two fuel tanks, one in each wing, with a total capacity of 132 litres (29 Imp. gallons). Two reserve fuel tanks under front seats with a total capacity of 54 litres (12 Imp. gallons). Oil tank (15 litres = 3.3 Imp. gallons) behind firewall.

ACCOMMODATION.—Enclosed cabin seating four in two pairs, front pair with dual controls. Two doors. One-piece moulded Plexiglas windshield.

DIMENSIONS.—
Span 11.30 m. (37 ft.).
Length 7.5 m. (24 ft. 7 in.).
Height (tail down) 2.20 m. (7 ft. 2½ in.).

WEIGHTS AND LOADINGS.—
Weight empty 690 kg. (1,518 lb.).
Weight loaded 1,190 kg. (2,618 lb.).
Wing loading 68 kg./m.² (13.94 lb./sq. ft.).
Power loading 7.5 kg./h.p. (16.5 lb./h.p.).

PERFORMANCE.—
Max. speed at S/L. 190 km.h. (119 m.p.h.).
Cruising speed at 1,000 m. (3,280 ft.) 150 km.h. (93 m.p.h.).
Rate of climb at S/L. 150 m./min. (492 ft. min.).
Service ceiling 2,600 m. (8,530 ft.).
Range in still air 500 km. (310 miles).



The LK-1 Four-seat Cabin Monoplane (160 h.p. Walter Minor JW-6-III engine)

ALL THE WORLD'S GUIDED MISSILES AND TEST VEHICLES

(CORRECTED TO SEPTEMBER 30, 1958).

THE BRITISH COMMONWEALTH

GREAT BRITAIN

ARMSTRONG WHITWORTH

SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT, LTD.

HEAD OFFICE AND WORKS: BAGINTON, NEAR COVENTRY, WARWICKSHIRE.

ARMAMENTS DIVISION: WHITLEY, NEAR COVENTRY.

Officers: See "Aircraft" section.

Armstrong Whitworth formed an Armaments Division in 1948, by which time the company already had considerable experience of producing liquid-propellent rocket motors for rocket test vehicles.

Main work of the Division has been the development of the Seaslug surface-to-air guided weapon for the Royal Navy, and it was announced in the Summer of 1958 that this missile had scored direct hits on target aircraft during operational trials without a warhead.

THE SEASLUG.

An official statement about this missile said: "Seaslug is the medium weapon which is designed to engage any enemy bomber which evades the fighter defences of the Fleet. It will do so at any height at which modern aircraft are capable of flying.

"Seaslugs are fired from a triple ramp launcher which is fed automatically from a magazine below decks. Targets are detected at long distances by radar and plotted accurately for range, height and bearing. This information enables any particular aircraft to be selected as the target for the missile. Using this information the missile guidance and control system positions the weapon launcher, and the operator determines when to fire the missile, without even seeing the target."

Early Seaslug test vehicles used a liquid propellent (nitric acid and methanol) sustainer and four wrapped boosters, each made up of two or three solid-propellent motors fastened together. The latest test round, shown at the 1958 S.B.A.C. display has a solid-propellent sustainer and four wrapped boosters, each of which is a single motor. This version is believed to be representative of the fully-developed version, now in production to arm initially the Royal Navy's four "Hampshire" class fleet escort super-destroyers, now under construction.



The Armstrong Whitworth Seaslug.

TYPE.—Surface-to-air ship-borne guided missile.

WINGS.—Fixed cruciform wings of rectangular shape, mounted more than half-way back on body. All-metal, conventional spar-and-rib structure.

BODY.—Cylindrical light-alloy construction.

TAIL SURFACES.—Pivoted cruciform tail surfaces at rear end, indexed in line with wings. Of similar construction to wings.

POWER PLANT.—One I.C.I. solid-propellent sustainer in body. Four solid-propellent boosters wrapped around forward part of body.

GUIDANCE.—Beam-riding. Main contractors are the Sperry Gyroscope Co. and the General Electric Co.

WARHEAD.—Initially high-explosive.

DIMENSIONS (approx.).—
Length 20 ft. (6.10 m.).
Body diameter 1 ft. 4 in. (0.41 m.).
Span of wings 5 ft. 3 in. (1.60 m.).
Span of tail 5 ft. 3 in. (1.60 m.).

WEIGHTS AND PERFORMANCE.—
No details available.

AVRO

A. V. ROE & CO., LTD.

HEAD OFFICE: GREENGATE, MIDDLETON, MANCHESTER.

Officers: See "Aircraft" Section.

WEAPONS RESEARCH DIVISION: WOODFORD, CHESHIRE.

Avro are developing the air-to-surface stand-off bomb which will be standard equipment on the Vulcan and Victor aircraft of R.A.F. Bomber Command. Flight trials were taking place from a Valiant bomber at Woomera during the Summer of 1958.

THE AVRO STAND-OFF BOMB.

Official code-name: Blue Steel.

Intended to make possible accurate attacks on heavily-defended targets, without requiring the launching aircraft to battle past the target's close defences, this stand-off bomb has a tail-first aeroplane configuration. Performance details are secret, but the managing director of A. V. Roe in South Australia has said that the weapon flies at supersonic speed at altitudes up to 60,000 ft (18,300 m.) after release 400 miles (640 km.) from the target. This may refer to a developed version with jet or ramjet power.

TYPE.—Air-to-surface guided weapon.

WINGS.—Cantilever monoplane of delta planform at rear of body. Small inboard ailerons.

BODY.—Streamlined, circular-section metal structure.

TAIL UNIT.—Tail-first design. Foreplane control surfaces. Folding lower tail fin. Fixed upper tail fin.

POWER PLANT.—Initially a liquid-propellent rocket motor. Possibly de Havilland Double Spectre.

GUIDANCE.—No details.

WARHEAD.—Nuclear type.

DIMENSIONS (approx.).—
Length 35 ft. (10.67 m.).
Span of wings 20 ft. (6.10 m.).

WEIGHT AND PERFORMANCE.—
No details available.

BRISTOL

THE BRISTOL AEROPLANE CO., LTD.

HEAD OFFICE AND WORKS: FILTON BRISTOL.

Officers: See "Aircraft" section.

The Bristol Aeroplane Company and Ferranti, Ltd., have collaborated for many years to develop a surface-to-air missile under the official code-name of "Red Duster". This weapon is now in production and in service with the R.A.F. as the Bloodhound.

Altogether four Bristol and two Ferranti factories are engaged in the production programme. The airframes are manufactured by Bristol Aircraft at Cardiff, the ramjet engines by Bristol Aero-Engines, and the majority of the electronics and guidance systems by Ferranti. The zero-length launchers are built by M.L. Aviation.

Several hundred development rounds have been fired with considerable success. In addition, the ramjets have been developed with the aid of more than 200 Bobbin test vehicles, of which details appeared in the 1957-58 edition of "All the World's Aircraft".

THE BLOODHOUND.

Official code-name: Red Duster.

First British surface-to-air guided missile to enter service, the Bloodhound began to equip the R.A.F. experimental weapon station at North Coates, Lincolnshire, in mid-1958 and will eventually become the standard R.A.F. home defence missile. It has also been ordered by the Royal Swedish Air Board.

The initial version has two 16 in. (406 mm.). ramjet engines of the Thor type: but Bristol Aero-Engines have more powerful ramjets under development. The Minister of Supply has referred to longer-range versions of Bloodhound being under development, including an anti-missile version.

TYPE.—Surface-to-air land-based guided missile.

WINGS.—Pivoting mid-wing monoplane type, mounted more than half-way back on body. All-metal structure with taper on leading and trailing edges. Wings can pivot either together or differentially, providing complete two-axis control.

BODY.—Cylindrical metal structure.

TAIL SURFACES.—Fixed mid-set cantilever monoplane type, in line with wing, at rear end of body.



POWER PLANT.—Two 16 in. (406 mm.) Bristol Thor ramjet sustainers, mounted above and below rear part of body. Four solid-propellent boosters wrapped around rear of body, with built-on stabilising fins.

GUIDANCE.—Semi-active homing type. Receiver in nose picks up reflected radiation from target when latter is illuminated by ground radar. Main contractor is Ferranti Ltd., with B.T.H. target-illuminating radar.

WARHEAD.—Initially high-explosive. Later nuclear.

DIMENSIONS.—
Length with boosters 25 ft. 3 in. (7.70 m.).
Body length 22 ft. 2 in. (6.76 m.).
Body diameter 1 ft. 9 in. (0.53 m.).
Span of wings 9 ft. 3 in. (2.82 m.).

WEIGHTS AND PERFORMANCE. —
No details available.

Bristol/Ferranti Bloodhound surface-to-air guided weapon on its M.L. transportable elevator-launcher. In the foreground is the loading trolley.

DE HAVILLAND

DE HAVILLAND PROPELLERS, LTD.

HEAD OFFICE AND WORKS : HATFIELD, HERTS.

OTHER WORKS : LOSTOCK, BOLTON, LANCS. ; FARNWORTH, BOLTON, LANCS. ; WALKDEN, LANCS.

President : Sir Geoffrey de Havilland, C.B.E., A.F.C., R.D.I., Hon. F.R.Ae.S., Hon. F.I.Ae.S.

Directors : W. E. Nixon, F.C.I.S. (Chairman) ; Sir Ralph Sorley, K.C.B., O.B.E., D.S.C., D.F.C., F.R.Ae.S.(Deputy Chairman and Managing) ; H. G. Sturgeon, O.B.E. (Deputy Managing) ; A. S. Kennedy, C.A. ; R. E. Bishop, C.B.E., F.R.Ae.S. ; G. C. I. Gardiner, F.R.Ae.S., M.I.Mech.E. (Chief Engineer) ; C. R. Burgess, M.B.E., A.F.R.Ae.S. (Sales) ; A. S. Wheate, C.A. (Secretary).

de Havilland Propellers entered the guided missile field in 1951, when they received a contract to develop turbo-alternators of the kind now fitted to the Bloodhound, Firestreak and Seaslug missiles, and a further contract covering development of an infra-red homing head.

First complete guided weapon for which the company received an official contract was an air-to-air missile code-named Blue Jay, which is now in quantity production to arm various R.A.F. and Fleet Air Arm interceptor fighters. It will be known in service as the Firestreak.

Design, research and development of Firestreak have been done at Hatfield. Components are manufactured at Lostock Works which is also responsible for testing. Manufacture and assembly of development rounds has been done at Farnworth. Production assembly will be centred in a new factory at Walkden.

In addition to their work on Firestreak, de Havilland Propellers are the prime contractors for Britain's long-range ballistic missile (L.R.B.M.), which is under intensive development at Hatfield under the code-name of Blue Streak.

THE DE HAVILLAND L.R.B.M.

Official code-name : Blue Streak.

Few details of this long-range ballistic missile have yet been released, except that it will have a Rolls-Royce liquid-propellent rocket engine, resulting from Rolls-Royce's technical assistance agreement with the North American Rocketdyne company, and a Sperry guidance system. It will have a range of 2,000-2,500 miles (3,200-4,000 km.) and will be launched from underground installations.

The L.R.B.M. is code-named Blue Streak and Saunders-Roe Ltd. are developing a test vehicle code-named Black Knight for re-entry trials of the Blue Streak warhead.

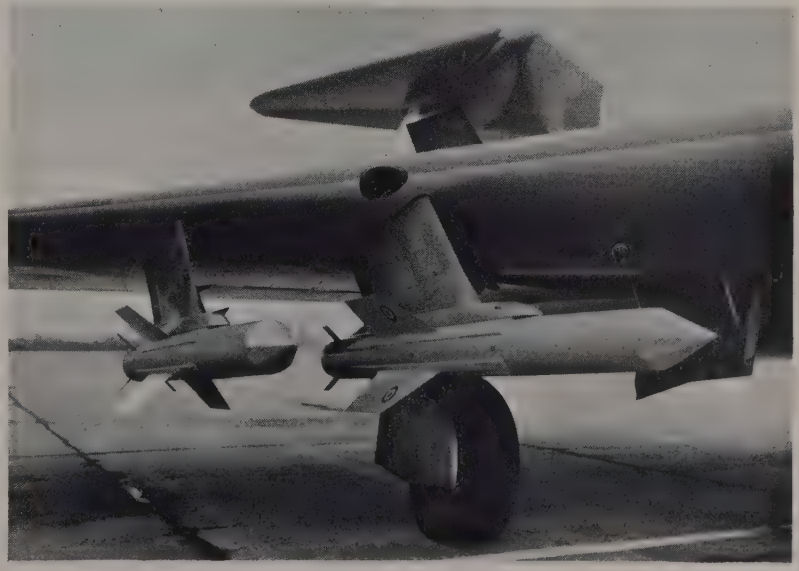
THE FIRESTREAK.

Official code-name : Blue Jay.

Designed to make possible the interception and destruction of high-speed bomber aircraft at great heights, Firestreak embodies an infra-red guidance system, which homes on to the heat emited by the engines of the target. This type of guidance offers considerable range, sensitivity and freedom from jamming, at the cost of reduced efficiency in cloud, so that unguided air-to-air rockets are usually carried as secondary armament.

Firestreaks will be the standard air-to-air guided weapons of the R.A.F. and Fleet Air Arm. They were due to enter service on the Gloster Javelin Mks. 7 and 8 in 1958, and will be carried also by the de Havilland Sea Vixen and English Electric Lightning.

de Havilland Propellers manufacture the entire weapon, except for the propulsion and explosive units which are produced by existing facilities within Government establishments. It can be fitted to virtually any interceptor by mounting under the aircraft's fuselage a small



The de Havilland Propellers Firestreak.

"weapon package" in a streamlined container, containing firing equipment that is carried inside the fuselage of the Javelin, Sea Vixen and Lightning.

TYPE.—Air-to-air guided missile.

WINGS.—Fixed cruciform wings with sweepback on leading-edges each machined from single piece of light alloy.

BODY.—Cylindrical all-metal structure.

TAIL SURFACES.—Pivoted cruciform surfaces at rear end, indexed in line with wings.

POWER PLANT.—One solid-propellent sustainer. No booster.

GUIDANCE.—Passive (infra-red) homing unit mounted in nose of missile behind eight optically-flat glass panels. Controls actuated pneumatically through rods carried in external fairings on body.

WARHEAD.—High-explosive.

DIMENSIONS.—
Length 10 ft. 5.28 in. (3.18 m.).
Body diameter 8.67 in. (0.22 m.).
Span of wings 2 ft. 5.4 in. (0.75 m.).
Span of tail 1 ft. 7.1 in. (0.49 m.).

WEIGHTS AND PERFORMANCE.—
No details available.

ENGLISH ELECTRIC

THE ENGLISH ELECTRIC CO., LTD.

HEAD OFFICE: QUEEN'S HOUSE, KINGSWAY, LONDON, W.C.2.

GUIDED WEAPONS DIVISION: STEVENAGE, HERTS. AND LUTON AIRPORT, BEDS.

Directors: See "Aircraft" section.

Chief Executive: Sir Conrad Collier, K.C.B., C.B.E.

Chief Engineer: L. H. Bedford, C.B.E., M.A., B.Sc., M.I.E.E.

Formed in 1949, the Guided Weapons Division of English Electric has been engaged since 1950 on the development of a surface-to-air guided weapon code-named Red Shoes. After successful test firings, it was announced in the spring of 1957 that this missile had been ordered for the British Army under the name of Thunderbird. A second contract for similar weapons for the R.A.F. was announced in September, 1957, and the Thunderbird is now in production. More advanced versions are known to be under development.



The English Electric Thunderbird.

THE THUNDERBIRD.

Official code-name: Red Shoes.

Like the Bloodhound, Thunderbird is a large surface-to-air weapon with semi-active radar homing, which has been developed in association with two other companies of the English Electric group, D. Napier & Son, Ltd., and Marconi Instruments, Ltd.

In its initial form, it had a Napier liquid-propellent sustainer very similar to the Double-Scorpion in design, but this has now been superseded by a solid-propellent motor, with consequent advantages in handling, storage, reliability and logistics.

English Electric have developed a complete range of ground equipment as part of the Thunderbird weapon system, including test equipment, carrier vehicles and the zero-length launcher, which is turned automatically and elevated at any angle up to 90° in accordance with signals from ground radar locked on to the target.

TYPE.—Surface-to-air land-based guided weapon.

WINGS.—Fixed cruciform wings with swept-back leading-edges, mounted well back on body. Each machined from piece of light alloy.

BODY.—Cylindrical structure made up of a number of light alloy centrifugal castings bolted together.

TAIL SURFACES.—Pivoted cruciform tail surfaces of tapered planform, on rear end of body, indexed in line with wings. Each machined from single piece of light alloy.

POWER PLANT.—One solid-propellent sustainer in body. Four solid-propellent boosters wrapped around rear part of body, each with large stabilising fin.

GUIDANCE.—Semi-active homing type. Main contractor is Marconi Instruments, Ltd.

WARHEAD.—Initially high-explosive. Later nuclear.

DIMENSIONS.—
Length 18 ft. 10½ in. (5.76 m.).
Body diameter 1 ft. 8¾ in. (0.63 m.).
Span of wings 5 ft. 6¾ in. (2.03 m.).
Span of tail 5 ft. 3 in. (1.92 m.).

WEIGHTS AND PERFORMANCE.—
No details available.

FAIREY

THE FAIREY AVIATION CO., LTD.

HEAD OFFICE AND WORKS: HAYES, MIDDLESEX.

GUIDED WEAPON DIVISION: HESTON, MIDDLESEX.

Head of G.W. Design and Development: L. R. E. Appleton, O.B.E., M.A., F.R.Ae.S.

General Manager, G.W.: J. A. C. Manson, B.Sc. (Eng.), F.R.Ae.S.

Fairey Aviation was the first British company to enter the guided weapon field when it began work on a small ship-to-air missile to counter the threat of Japanese *Kamikaze* suicide-bombers towards the end of World War 2. This weapon was developed subsequently into the Stooge general-purpose test vehicle; and the company also completed a successful test programme with rocket-powered VTO models intended to simulate a piloted ramp-launched interceptor fighter.

Work on air-to-air weapon systems began in 1949, and led to the development of a beam-riding missile code-named Blue Sky. After very successful firing tests, during which it became the first British missile to destroy a target aircraft, this weapon was ordered into production for the R.A.F. as the Fireflash. It is being used for training and development of tactics by a special R.A.F. squadron equipped with Supermarine Swift Mk. 7 fighters, and has been fitted experimentally to the Hawker Hunter and other types.

The Fairey Weapon Division is also developing and producing the standard anti-tank guided weapon for the British Army, but all details are secret.

THE FIREFLASH.

Official code-name: Blue Sky.

This air-to-air weapon is unique in that it consists of an unpowered dart which is accelerated to maximum speed by two boosters. These jettison on burn-out, after which the missile coasts to the target.

Its control fins are locked during the boost phase, the weapon being spin-stabilised by the offset nozzles of the boosters. When the boosters are jettisoned, the control surfaces are unlocked and the Fireflash is centred in a coded radar beam transmitted by a small radar unit in the nose of the launching aircraft. The beam is held on target by the pilot of the aircraft, using a conventional gun-sight.

TYPE.—Air-to-air guided weapon.

WINGS.—Fixed cruciform wings with slight leading-edge sweepback, mounted mid-way

down body. Each consists of a light-alloy forging.

BODY.—Cylindrical structure comprising a magnesium-zirconium alloy extruded tube.

TAIL SURFACES.—Pivoted cruciform tail surfaces of tapered planform, on rear end of body, indexed at 45° to wings. Each consists of a light-alloy forging.

POWER PLANT.—No sustainer. Two 5 in. (127 mm.) diameter steel-cased cordite boosters, each fitted with cruciform stabilising fins.

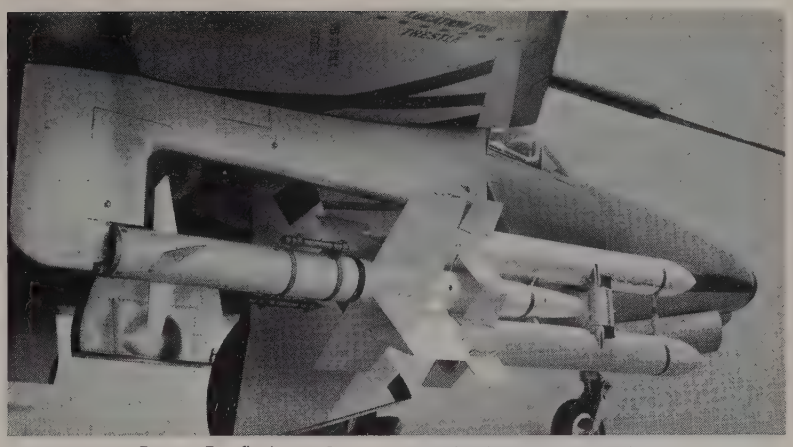
GUIDANCE.—Beam-riding type, using receivers in missile produced by Plessey and radar of Ekco design in the launching interceptor. Controls are actuated pneumatically.

WARHEAD.—High-explosive warhead, with proximity fuse.

DIMENSIONS.—
Length with boosters 9 ft. 3¾ in. (2.83 m.).
Length of body 7 ft. 5 in. (2.26 m.).
Span of wings 2 ft. 4 in. (0.71 m.).
Span of tail 1 ft. 6 in. (0.46 m.).

WEIGHT.—Firing weight 300 lb. (136 kg.).

PERFORMANCE.—
No details available.



Fairey Fireflash on Supermarine Swift Mk. 7 aircraft.

PYE

PYE LTD.

HEAD OFFICE AND WORKS: CAMBRIDGE.

ENGINEERING DEPARTMENT: ROYSTON, HERTS.

Directors: C. O. Stanley, C.B.E. (Chairman); L. G. Hawkins; C. A. W. Harmer, O.B.E.; E. J. W. Stanley, M.A., B.Sc. (Eng.); J. O. Stanley, M.A.; N. A. Twemlow, M.B.E.; B. J. Edwards, M.B.E., M.I.E.E.

Chief Engineer: J. W. Dalgleish.

Engineer in charge, G. W. Section: C. L. Paice.

Pye have produced as a private-venture an infantry anti-tank guided weapon.



The Pye anti-tank guided weapon.

After many successful trial firings, it was shown publicly for the first time at the 1958 S.B.A.C. Display.

THE PYE GUIDED WEAPON.

Designed as the most-lethal anti-tank weapon that can be carried for short distances and fired by one man, the Pye guided weapon is wire-guided and controlled by means of a hand-held thumb-button control unit and prismatic monoculars. The magnification of the monoculars can be increased as the weapon flies further towards the target.

There are no aerodynamic controls and the weapon is steered by masking the row of sustainer motor nozzles around the body aft of the wing trailing-edges.

TYPE.—Surface-to-surface guided weapon.

WINGS.—Fixed cruciform wings mid-way back on body. Wire-guidance bobbins on two wing-tips. Tracking flares on other wing-tips.

BODY.—Cylindrical metal structure.

TAIL SURFACES.—None.

POWER PLANT.—Two-stage solid-propellent rocket motor produced by Bristol to Pye design. Second stage exhausts through peripheral outlets aft of wing trailing-edges.

GUIDANCE.—Wire command.

WARHEAD.—Large hollow-charge high-explosive type with impact fuse.

DIMENSIONS.—
Length 5 ft. (1.52 m.).
Span of wings 2 ft. (0.61 m.).

WEIGHT AND PERFORMANCE.—
No details available.

R.A.E.

ROYAL AIRCRAFT ESTABLISHMENT.

ADDRESS: FARNBOROUGH, HANTS.

Director: G. W. H. Gardner, C.B., C.B.E., B.Sc., M.I.Mech.E., F.R.Ae.S.

Head of G.W. Department: E. C. Cornford, B.A.

In addition to its work as a research, design and development centre in the service of the industry as a whole, the R.A.E. has designed the Skylark high-altitude sounding rocket which represents part of Britain's contribution to International Geophysical Year research. Brief details of the Skylark are given hereafter.

THE SKYLARK.

The Skylark is a ramp-launched high-altitude research rocket containing about 5 cub. ft. (0.14 m.³) of payload space in its nose-cone and a portion of its body. These compartments can be pressurised and the nose-cone is designed to jettison for certain experiments.

Initially, the Skylark was intended to carry a payload of 100-150 lb. (45-68 kg.) to a height of 95 miles (153 km.), but later versions, with more powerful motors, have improved performance.

Typical of the equipment carried by the Skylark was that fitted in the fourth one fired from Woomera on November 13, 1957. It ejected a series of 18 explosive grenades at intervals above 100,000 ft. (30,500 m.); so that ground equipment could record the arrival of sound-waves and the position and time of each flash, to obtain data on atmospheric temperatures and high-altitude wind velocities. Fourteen cartridges of "window" foil were also released in two clouds above 100,000 ft. (30,500 m.) and tracked by radar to measure wind speed and direction. A section of the nose was insulated to form a fixed-capacity condenser to measure ionospheric electron densities, the data being telemetered to the ground. Finally, three Pirani pressure gauges were carried in the rocket cone to determine the undisturbed ambient pressure at various altitudes, one measuring ram pressures at the tip and the other two measuring cone wall pressures.

Skylark has cruciform sweptback wings at its tail end and is 25 ft. (7.62 m.) long. The initial version is powered by a Bristol Raven solid-propellent motor giving 11,500 lb. (5,215 kg.) s.t. for 30 sec. Standard instrumentation includes a 465 mc/s. telemetry transmitter, Doppler transponder and a 6 cm. micro-wave beacon.

SARO

SAUNDERS-ROE LIMITED.

HEAD OFFICE AND WORKS: OSBORNE, EAST COWES, ISLE OF WIGHT.

Officers: See "Aircraft" section.

Saunders-Roe have designed an experimental rocket, known by the code-name of Black Knight, for use initially as a re-entry test vehicle for the nose-cone and warhead of the de Havilland Blue Streak LRBM.

Initial static tests of Black Knight were made at the Needles testing site in the Isle of Wight, which was opened by Saunders-Roe on behalf of the Ministry of Supply in 1956.

THE BLACK KNIGHT.

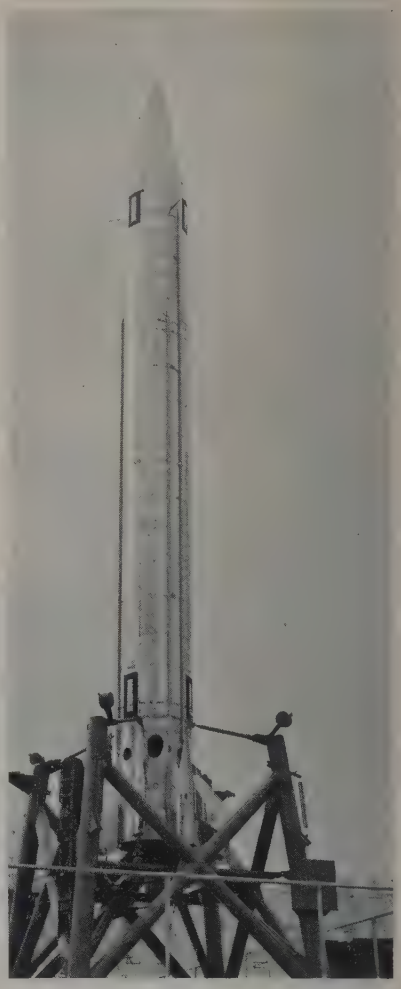
Black Knight is a single-stage research rocket approx. 35 ft. (10.67 m.) long and 3 ft. (0.91 m.) in diameter, which has been designed and built by Saunders-Roe in collaboration with the Royal Aircraft Establishment. It is powered by a liquid-propellent rocket engine

developed by Armstrong Siddeley from an original design by the Rocket Propulsion Department of the R.A.E. at Westcott. This engine has four gimbal-mounted nozzles for directional control of the missile in flight.

Details of Black Knight were released on September 7, 1958, after a firing on the Woomera range in Australia. It was the first time that the missile had been launched and the test proved satisfactory in every respect. Further firings were scheduled to follow before the end of 1958.

An official statement said that after rising vertically from the launcher, Black Knight is controlled to climb vertically for several thousand feet, after which it is directed into a climb path towards the target area. From the point of engine cut-off, it coasts upward to a height of several hundred miles and then descends until it reaches the fringes of the atmosphere above the target.

Measurements of the behaviour of the rocket engine, the control and guidance systems and the conditions during acceleration under power, together with data on the environment and other phenomena are telemetered to the ground during flight by several transmitters in the missile. Its behaviour during re-entry into the atmosphere is recorded. Additional information is obtained by tape-recorders and by recovery of the missile after impact.



The Saunders-Roe Black Knight.

SHORT

SHORT BROTHERS AND HARLAND LTD.

HEAD OFFICE AND WORKS: QUEEN'S ISLAND, BELFAST, N. IRELAND.

Officers: See "Aircraft" section.



The Short SXA.5.

For the first six years of its existence, Short's Guided Weapon Department at Castlereagh, near Belfast, was engaged mainly on the development and manufacture of the widely-used G.P.V. (general-purpose test vehicle) of which details were given in the 1957-58 edition of "All the World's Aircraft".

A further product, exhibited at the 1957 S.B.A.C. Display, is the SXA.5, described as a multi-purpose surface-to-air test vehicle. This almost certainly forms the basis of the ship-to-air anti-aircraft weapon for use against low-flying aircraft for which the company was awarded a contract in the Spring of 1958, and all available details are given hereafter.

THE SHORT SXA.5.

TYPE.—Surface-to-air test vehicle.

WINGS.—Movable cruciform wings to provide control in pitch and yaw. Sweptback leading-edges. Each made from single sheet of light alloy, riveted over root and tip ribs.

BODY.—Basically cylindrical-section all-metal structure, with widened square-section centre-body at wing roots.

TAIL SURFACES.—Fixed cruciform tail surfaces of rectangular planform, mounted at rear of missile and indexed at 45° to wings. Each carries a flare at its tip.

POWER PLANT.—Probably one solid-propellent sustainer.

GUIDANCE.—Presence of flares on tips of tail surfaces implies the possible use of radio command guidance system.

DIMENSIONS.—
Length 6 ft. 5.2 in. (1.96 m.).
Body diameter 9.5 in. (0.24 m.).
Span of wings 2 ft. 7 in. (0.79 m.).
Span of tail 2 ft. 7 in. (0.79 m.).

WEIGHTS AND PERFORMANCE.—
No details available.

VICKERS

VICKERS - ARMSTRONGS (AIRCRAFT), LTD.

HEAD OFFICE: VICKERS HOUSE, BROADWAY, LONDON, S.W.1.

Directors: See "Aircraft" section.

GUIDED WEAPONS DEPARTMENT: WEYBRIDGE, SURREY.

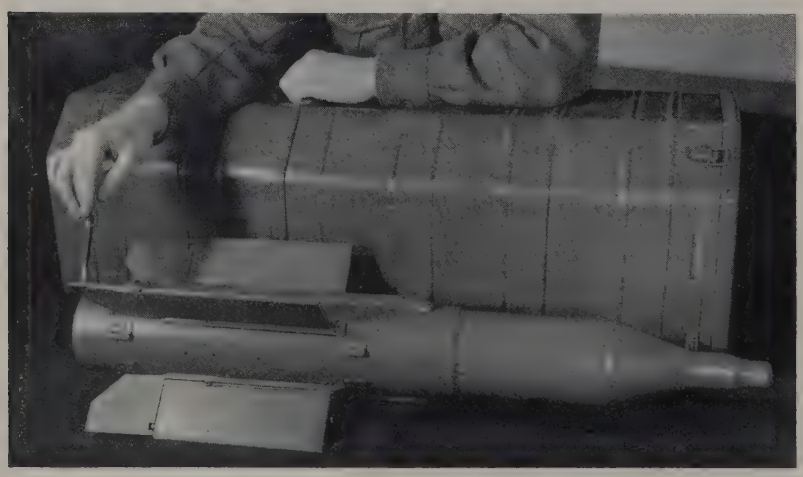
Chief Engineer: Brig. J. Clemow, M.A.

Chief Designer: H. Surtees, M.Sc.

First projects in the guided missile field undertaken by Vickers eight years ago were an air-to-surface guided bomb to be carried by the Valiant bomber and a pilotless bomber powered by a Rolls-Royce turbojet engine and with Ferranti guidance.

To handle this work the company formed a Guided Weapons Department in 1952. In the same year, a further very important official contract was received for an air-to-air missile code-named Red Dean (Vickers Type 888) to arm the projected "thin-wing Javelin" all-weather interceptor. Details of this weapon were given in the 1957-58 edition of "All the World's Aircraft".

When further development of the "thin-wing Javelin" was abandoned, there was no longer a requirement for Red Dean. As the other contracts had also been cancelled, Vickers began work in 1956, as a private venture, on a light surface-to-surface guided missile capable of being carried and operated by a single infantryman. This weapon, the Vigilant, was expected to be fully-developed by the end of 1958, and is described below.



The Vickers Vigilant with its combined canister-launcher.

THE VICKERS TYPE 891 VIGILANT.

The Vigilant is an extremely simple, compact and lightweight surface-to-surface missile, intended for use by infantry. It can be transported in a light waterproof fabric bag, complete with a tubular zero-length launcher, the whole package weighing approx. 35 lb. (15.9 kg.). Alternatively, it can be stored and carried in a more sturdy square-section canister with integral launching rail, in

which form the total weight is about 45 lb. (20.4 kg.).

A wire-guidance control system is used, the operator directing the missile to the target visually, by means of a thumb-stick attached to a pistol-grip device. A flare attached to the weapon makes its position easy to track during flight and tests have shown that any average person can achieve quickly a high degree of accuracy. To facilitate and reduce the cost of training, Vickers have developed an electronic simulator which reproduces precisely the flight and control of the missile over all ranges within its capabilities.

The small wing-span of the missile reduces the possibility of its striking obstructions such as the branches of trees during flight. It can be fired remotely by connecting a lead from the weapon to the pistol grip, and this permits a single operator to be in command of several dispersed weapons.

TYPE.—Surface-to-surface guided weapon.

WINGS.—Fixed cruciform wings of rectangular planform, mounted at rear of body and fitted with pneumatically-actuated trailing-edge control surfaces. Plastics structure.

BODY.—Cylindrical light-alloy structure.

TAIL SURFACES.—None.

POWER PLANT.—One I.C.I. solid-propellent sustainer. No booster.

GUIDANCE.—Wire command guidance, through fine wire which unwinds from a coil inside the launching canister as missile flies towards the target. Trigger firing. Thumbstick steering. Visual tracking supplemented by monocular for long-range operation.

WARHEAD.—Various explosive types, including a hollow-charge warhead capable of piercing the heaviest known AFV armour. Retractable contact probe.

DIMENSIONS.—
Length 2 ft. 9 in. (0.84 m.).
Body diameter 4.5 in. (0.11 m.).
Span of wings 11 in. (0.28 m.).

WEIGHT.—
With container and ramp 35-45 lb. (15.9-20.4 kg.).

PERFORMANCE (approx.).—
Speed 350 m.p.h. (565 km.h.).
Range 1 mile (1.6 km.).

AUSTRALIA

GOVERNMENT FACTORIES

DEPARTMENT OF DEFENCE PRODUCTION, DIVISION OF AIRCRAFT PRODUCTION.

HEAD OFFICE: 8TH FLOOR, 339 SWANSTON STREET, MELBOURNE, VICTORIA.

Officers: See "Aircraft" section.

Following its highly-successful development of the Jindivik target drone, the same basic design team at the Australian Government Aircraft Factories has designed an anti-tank weapon named the Malkara, to meet a British Army requirement. All available details are given hereafter.

THE MALKARA.

Somewhat larger than the Vickers Type 891, the Malkara is a surface-to-surface weapon for use by anti-tank units rather than by infantry. Few details were available at the time of writing, except that it weighs 200 lb. (91 kg.), is guided by radio and is intended to be launched normally from fighting vehicles against tanks, landing craft and concrete emplacements.

The British Minister of Supply announced in August, 1958 that 150 Malkaras, costing about £320,000 had been ordered by Britain. An additional batch of 30 had already been supplied at that time for acceptance trials.

CANADA

C.A.R.D.E.

CANADIAN ARMAMENT RESEARCH AND DEVELOPMENT ESTABLISHMENT.

This Establishment was stated, in April 1957, to have designed and developed a homing torpedo, intended primarily for launching from the air against submarines.

No details are available, but it was expected that the weapon would enter service with the R.C.A.F. and R.C.N. during 1958.

CANADAIR

CANADAIR, LTD.

HEAD OFFICE AND WORKS: CARTIERVILLE AIRPORT, MONTREAL, P.Q.

Officers: See "Aircraft" section.

Canadair's first major guided weapon project was the design and development of an air-to-air missile known as Velvet Glove. When the contract for this was cancelled the company undertook the development and production of the Sparrow II air-to-air missile. This was originally a Douglas Aircraft project, intended to arm the abandoned F5D Skylancer naval interceptor, and production in Canada was arranged through a licence agreement with Douglas.

The Sparrow II contract with Canadair, Ltd. was cancelled in September, 1958.

THE SPARROW II.

Sparrow II is a development of the Sparrow I air-to-air guided weapon which has been operational with the U.S. Navy since 1955. In its original form, as designed by Douglas Aircraft, it had a radar active-homing guidance system.

Designed with a view to mass production, the Sparrow II can be used on both day and all-weather interceptors, and is manoeuvrable enough for use against small jet fighters, even at high altitudes. It is compatible with all airborne interceptor radars.

Production in Canada was intended for the Avro Arrow interceptor, with missile airframes by Canadair and guidance by Canadian Westinghouse Co., Ltd., of Hamilton, Ontario, but the contract was cancelled as an economy measure in September, 1958.

No specification or performance details are available, except that Sparrow II is 12 ft. 6 in. (3.80 m.) long and weighs under 500 lb. (227 kg.).

FRANCE

D.E.F.A.

DIRECTION DES ETUDES ET FABRICATIONS D'ARMEMENT.

D.E.F.A. co-ordinates the work of several separate research and production units, including the following :

Le Laboratoire de Recherches Balistiques et Aérodynamiques, at Vernon, which has the most powerful supersonic wind tunnel in France, as well as much other test equipment.

L'Etablissement d'Expériences Techniques, at Versailles, which has conducted extensive research into the use of solid propellents in collaboration with the *Direction des Poudres*.

L'Atelier de Constructions, at Puteaux, which is responsible for pre-production of D.E.F.A. missiles.

L'Etablissement d'Experiences Techniques, at Bourges, which is responsible for missile testing both in France and at Colomb-Bechar.

Most important D.E.F.A. projects are the Entac anti-tank missile, Maruca test vehicle, Masurca ship-to-air weapon and Parca surface-to-air weapon, all of which are described hereafter.



The D.E.F.A. PARCA.

THE ENTAC

Entac (Engin Tactique Anti-Chars) is a small wire-guided anti-tank missile similar in most respects to the Nord 5203 and carrying the same official designation of SS.10. It is manufactured by D.E.F.A. instead of by the aircraft industry as such.

THE MARUCA

Developed for the French Navy, Maruca has an aeroplane configuration, with slightly swept wings and a cruciform tail. It is ramp-launched, with the aid of four solid-propellent boosters mounted on the fuselage above and below the wing-roots. Wing-tip tracking flares are fitted.

Maruca is being used for training in missile handling and firing techniques, and as a test vehicle for components of the operational Masurca ship-to-air guided weapon.

THE MASURCA.

No details of Masurca are available, except that it is destined to be the chief defensive weapon of French naval craft against aircraft of very high performance. Components are being tested on the Maruca test vehicle.

THE PARCA.

PARCA (Projectile Autopropulsé Radioguidé Contre Avions) is the first operational French surface-to-air guided weapon. The initial version, in service with the French Army, lacks the performance to be fully effective against modern aircraft, but versions with higher performance are under development.

As with the British Thunderbird, PARCA'S launching ramp is kept "on target" in bearing and elevation by signals from a radar tracking unit before the missile is fired. This reduces the amount of manoeuvring which the weapon has to perform in flight and, hence, the interception time.

On firing, PARCA is accelerated quickly to supersonic speed by its boosters, which then fall away. Its angular co-ordinate and that of the target are tracked continuously by direction-finders, which bring the two together by a radar command system until the weapon is near enough to be detonated by its proximity fuse.



The D.E.F.A. Maruca.

TYPE.—Surface-to-air land-based guided weapon.

WINGS.—Fixed cruciform wings of delta planform mounted at rear end of missile. Each machined from solid light alloy.

BODY.—Cylindrical light-alloy structure.

TAIL SURFACES. — Tail - first configuration. Cruciform movable control surfaces at front of missile, indexed at 45° to wings.

POWER PLANT.—One S.E.P.R. liquid-propellent (nitric acid and furaline) motor in body. Four S.E.P.R. solid-propellent boosters wrapped around rear part of body, each with large stabilising fin.

GUIDANCE.—Radar command.

WARHEAD.—High explosive.

DIMENSIONS.—
Length with boosters approx. 5.50 m. (18 ft.).
Length of body 5.10 m. (16 ft. 8½ in.).
Span of wings 1.60 m. (5 ft. 3 in.).

WEIGHT.—
Firing weight approx. 1,000 kg. (2,200 lb.).

PERFORMANCE.—
Speed at burn-out Mach 1.7.
Ceiling 25,000 m. (82,000 ft.).

MATRA

SOCIÉTÉ MATRA.

Matra have been engaged for some years on the development of an air-to-air guided weapon to arm the Mystère, Vautour and later French interceptors. Some of the early test vehicles and development missiles had an S.E.P.R. liquid-propellent sustainer ; but the production-type Matra R.510 has a two-stage solid-propellent motor.

THE MATRA R.510.

Several variants of the R.510 have been produced, some with small twin stabilising fins at the tips of their rear-mounted wings ; but all are basically the same, with a unique photo-cell type of active homing guidance.

The photo-cell is mounted in the nose behind a small window which gives it a field of view within a 20° cone. By sensing variations in light and shade within this cone, it is able to fix the angular co-ordinates of the target. An electronic device combines this information with data on the missile's speed and angular acceleration fed into it by sensing units in the autopilot. The resultant signals are passed to the servos which actuate the foreplane and rudder.

After extensive testing on Meteor and Canberra aircraft, the R.510 is now in production as standard armament for current and future types of French interceptor aircraft.

TYPE.—Air-to-air guided weapon.

WINGS.—Cantilever monoplane type, with 10° dihedral, mounted at rear of missile. Some versions have wing-tip stabilising fins.

BODY.—Cylindrical light-alloy structure.

TAIL SURFACES.—Tail-first configuration. Movable foreplane at front of missile and rudder under wings at rear of missile.

POWER PLANT.—One two-stage solid-propellent motor, of which the first stage develops the greater thrust and functions as a booster.

GUIDANCE.—Active homing, through auto-director photocell.

WARHEAD.—High explosive charge weighing 30 kg. (66 lb.), with proximity fuse.

DIMENSIONS.—
Length 3.20 m. (10 ft. 6 in.).
Body diameter 0.28 m. (11 in.).
Span of wings 1.00 m. (3 ft. 3½ in.).

WEIGHT.—
Firing weight 170 kg. (375 lb.).

PERFORMANCE.—
Speed at burn-out Mach 1.7.
Operational altitude 3,000-15,000 m. (9,850-49,200 ft.).
Max. range 8 km. (5 miles).



The Matra R.510 air-to-air weapon.

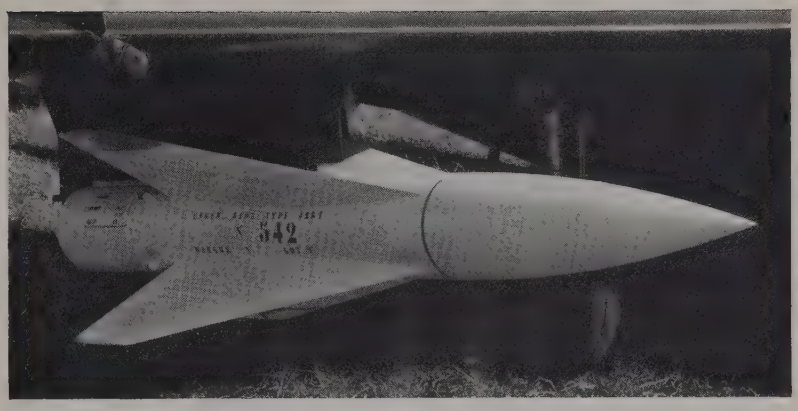
NORD

NORD-AVIATION, SOCIÉTÉ NATIONALE DE CONSTRUCTIONS AÉRONAUTIQUES.

HEAD OFFICE : 12*bis*, AVENUE BOSQUET, PARIS (7e).

Officers : See "Aircraft" section.

In addition to their work on pilotless target aircraft, described in the "Aircraft" section of this book, Nord have been engaged on the design, development and production of guided missiles and test vehicles for many years. All available information on the latest of these is given hereafter.

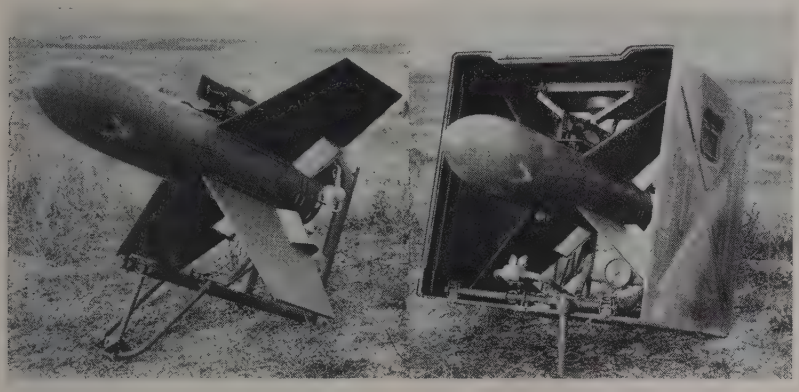


The Nord 5103 air-to-air guided weapon.

THE NORD 5103 (AA. 20.)

The Nord 5103, or AA.20 is in quantity production for the French Air Force as an air-to-air missile and has been fired at supersonic speed from a Nord Gerfaut II research interceptor. It is designed for use also in an air-to-surface rôle against pin-point ground targets.

A radio command guidance system is used, the missile being steered to the target visually by means of a small control column in the launching fighter aircraft. The signals transmitted to the missile are coded to reduce the possibility of jamming, and they control it directionally by causing the rocket efflux to be deflected.



The Nord SS.10 on lightweight launcher (*left*) and in container-launcher (*right*).

TYPE.—Air-to-air and air-to-surface guided weapon.

WINGS.—Fixed cruciform wings of heavily-swept planform.

BODY.—Cylindrical all-metal structure.

TAIL SURFACES.—None.

POWER PLANT.—One two-stage solid-propellent motor, of which the first stage develops the greater thrust and functions as a booster.

GUIDANCE.—Radio command from launching fighter aircraft, through jet deflection system.

WARHEAD.—Either a training head or explosive type with heavy charge. Proximity fuse. Self-detonator to destroy missile if it misses target.

DIMENSIONS.—
Length 2.66 m. (8 ft. 6½ in.).
Body diameter 0.25 m. (10 in.).
Span of wings 0.80 m. (2 ft. 7½ in.).

WEIGHT.—
Firing weight (air-to-air) 141 kg. (295 lb.).
Firing weight (air-to-surface) approx. 170 kg. (380 lb.).

PERFORMANCE.—
Speed at burn-out Mach 1.7.
Max. range 4 km. (2½ miles).

THE NORD 5203 (SS.10).

One of the few guided weapons used in action, this simple wire-guided anti-tank missile was employed successfully by the Israel Army against Egyptian armoured fighting vehicles during the Suez campaign of 1956. It is in service with the French, Swedish and Federal German Forces and has been ordered for the U.S. Army. Production is at the rate of 450-500 each month.

When fired by infantry, the container in which the SS.10 is supplied converts into a zero-length launching ramp. It can also be launched from Jeeps, light aircraft and helicopters. So effective is its guidance that a high proportion of direct hits can be gained by the operator after very little practice.

TYPE.—Surface-to-surface and air-to-surface guided missile.

WINGS.—Fixed cruciform wings with small control surfaces inset in wing-root trailing-edges.

BODY.—Cylindrical all-metal structure.

TAIL SURFACES.—None.

POWER PLANT.—One solid-propellent sustainer. No booster.

GUIDANCE.—Wire-command, in which radio signals are passed through two fine wires which unwind as missile travels towards target.

WARHEAD.—Shaped charge weighing 5 kg. (11 lb.), with impact fuse. Warhead attached to body by three toggle fasteners.

DIMENSIONS.—
Length 0.86 m. (2 ft. 10 in.).
Span of wings 0.75 m. (2 ft. 5½ in.).

WEIGHT.—
Firing weight 15 kg. (33 lb.).
Weight with container 40 kg. (88 lb.).

PERFORMANCE.—
Speed 300 km.h. (186 m.p.h.).
Max. range 1.6 km. (1 mile).

THE NORD 5210 (SS.11.)

Although larger and with a higher performance than the Nord 5203 (SS.10), the Nord 5210 offers the same flexibility of employment. It utilises a similar wire command guidance system ; but directional control is achieved by varying the thrust of the two rocket effluxes, on each side of its body. Like the SS.10, this missile rotates in flight. It has swept wings and a solid-propellent motor.

The SS.11 is in quantity production for the French services.

DIMENSIONS.—
Length 1.08 m. (3 ft. 6½ in.).
Body diameter 0.16 m. (6 in.).
Span of wings approx. 0 66 m. (2 ft. 2 in.).

WEIGHTS.—
Firing weight 31 kg. (69 lb.).
Warhead 6.8 kg. (15 lb.).

PERFORMANCE.—
Speed 700 km.h. (435 m.p.h.).
Max. Range 3.5 km. (2.2 miles).

THE NORD ST. 450.

Nord have been developing ramjet engines suitable for piloted aircraft and missile applications since 1950. One of the test vehicles used in this programme for the past four years is the ST.450. Made largely of steel, this consists of a circular-section ramjet of 450 mm. (17.7 in.) diameter, with concentric centre-body housing the fuel tank, control and test equipment and recovery parachute.

The ST.450 has movable foreplane control surfaces. Cruciform sweptback



The Nord SS.11 on multiple launcher.

wings are mounted on the detachable rear body, which constitutes the integral combustion chamber. It is launched from a ramp 8 m. (26 ft.) long, at any angle from 60 to 80° above the horizontal, by means of an assembly of two solid-propellent boosters. These accelerate it to a speed of 300-500 m./sec. (985-1,640 ft./sec.), after which the ramjet is able to take over. Its flight path is controlled by a programming autopilot.

The center-body, containing the most important parts of the engine and the test instruments, has been recovered safely from ST.450 test vehicles which attained speeds above Mach 2.5 and heights up to 35,000 m. (115,000 ft.).

DIMENSIONS.—
Length 4.70 m. (15 ft. 5 in.).
Body diameter 0.45 m. (1 ft. 5¾ in.).
Span of wings 1.05 m. (3 ft. 5 in.).

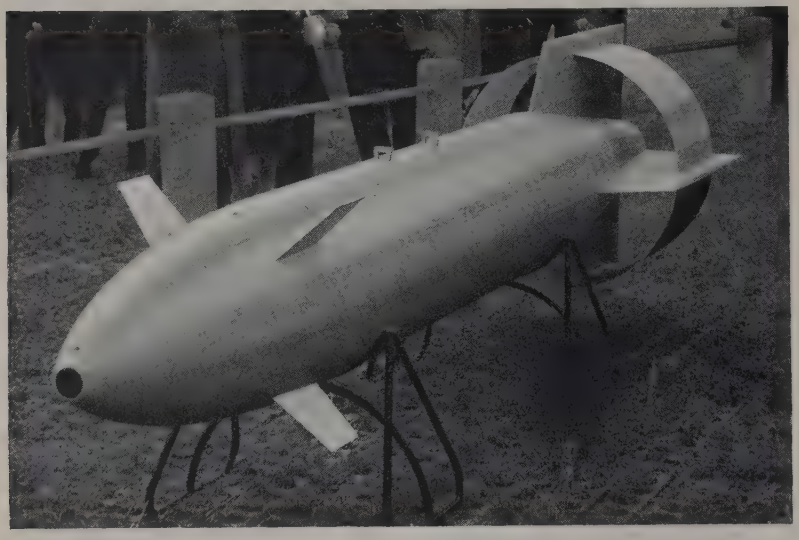
WEIGHTS.—
Firing weight of vehicle 175-225 kg. (385-500 lb.).
Fuel 35 kg. (77 lb.).
Weight of booster assembly 330-400 kg. (725-880 lb.).

PERFORMANCE.—
Max. speed Mach 4.



The Nord ST. 450.

SUD



The B.B. 10 guided bomb.

SUD-AVIATION, SOCIÉTÉ NATIONALE DE CONSTRUCTIONS AÉRONAUTIQUES.

HEAD OFFICE: 37, BOULEVARD DE MONTMORENCY, PARIS (16e).

Officers: See "Aircraft" section.

Sud-Aviation is continuing development of the series of surface-to-air missiles designed by the former Sud-Est company, the latest version being the S.E.4300. Other products in this field are the air-to-surface B.B.10 guided bomb for the Vautour bomber and the surface-to-surface S.E.4200.

THE B.B. 10.

Intended primarily to be carried by the Vautour bomber, the B.B.10 is a comparatively large powered and guided bomb. It is stated to be controlled by radio command from the launching aircraft, by a controller who can "see" the target through a small window in the missile's nose. This implies, presumably, that the nose contains a small television camera and transmitter.

TYPE.—Air-to-surface guided weapon.

AERODYNAMIC SURFACES.—Cruciform nose control surfaces. Cruciform fixed tail surfaces indexed at 45° to foreplanes and linked by annular shroud.

BODY.—Streamlined metal structure.

POWER PLANT.—One smokeless solid-propellent sustainer. No booster.

GUIDANCE.—Radio command from launching aircraft, with television link in missile nose through which controller can "see" a distant target.

WARHEAD.—High explosive charge of approx. 180 kg. (400 lb.).

DIMENSIONS (approx.).—
Length 3.35 m. (11 ft.).
Span of rear fins 0.80 m. (2 ft. 8 in.).

WEIGHT (approx.).—
Launching weight 400 kg. (900 lb.).

PERFORMANCE.—
No details available.

THE S.E. 4200.

Under development since about 1950, this unique tailless ramjet-powered bombardment missile has been built in limited numbers for service with the French Army.

It is launched from a zero-length ramp, which can be mounted on a truck or armoured vehicle, by means of two solid-propellent boosters. Originally, these were attached above and below the body; but both are now mounted under the missile, to each side of the pylon carrying the underslung streamlined warhead container.

In flight, the S.E. 4200 is stabilised by a gyroscopic device which operates the rudders at the wing-tips and trailing-edge elevons. Its altitude is controlled by a sensitive altimeter. Guidance is by radio command; and a telemetry system is incorporated to plot the missile's position, so that it can be made to dive into the target by a radio signal at the appropriate point.

TYPE.—Surface-to-surface land-based guided weapon.

WINGS.—Cantilever mid-wing monoplane, with moderate sweepback. Rudders, with



The S.E. 4300.



The S.E. 4200 on its lightweight ramp.

built-on tracking flares, at tips. Elevons in trailing-edges.
BODY.—Double-walled cylindrical structure forming integral ramjet.
TAIL SURFACES.—No horizontal tail surfaces.
POWER PLANT.—One integral ramjet sustainer, burning kerosene fuel contained in internal tanks. Two solid-propellent boosters.
GUIDANCE.—Radio command from ground.
WARHEAD.—Large high-explosive charge in underslung streamlined pod.
DIMENSIONS.—
Length without boosters approx. 3 m. (10 ft.).
Span of wings 2.15 m. (7 ft. 1 in.).
WEIGHT.—
Launching weight 300 kg. (660 lb.).
PERFORMANCE (approx.).—
Cruising speed Mach 0.9.
Range 100 km. (62 miles).

THE S.E. 4300.

Latest Sud-Aviation surface-to-air missile of which details may be given, the S.E. 4300 is an interim weapon, intended mainly as a test vehicle for guidance systems and for training personnel in missile handling and firing.
TYPE.—Two-stage surface-to-air guided weapon.
WINGS.—Cruciform sweptback wings, with wingtip tracking flares.
BODY.—All-metal streamline structure.
TAIL SURFACES.—Large cruciform tail fins mounted on booster. Indexed at 45° to wings.
POWER PLANT.—One liquid-propellent sustainer. One solid-propellent booster in line.
GUIDANCE.—Radio command from ground.
DIMENSIONS (approx.).—
Length with booster 5.50 m. (18 ft.).
Span of wings 2.15 m. (7 ft. 1 in.).
WEIGHT (approx.).
Firing weight 1,000 kg. (2,200 lb.).
PERFORMANCE.—
No details available.

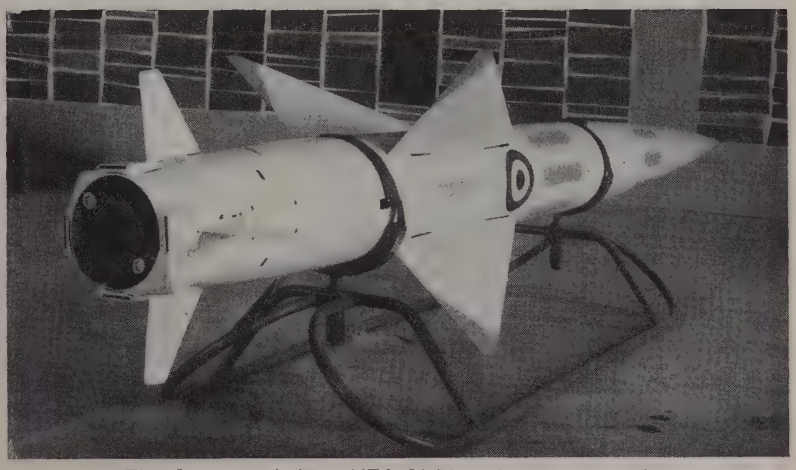
ITALY

CONTRAVES ITALIANA

Contraves Italiana is an associate of the Swiss Oerlikon company and its main current product is a version of the Oerlikon Type 56 surface-to-air guided weapon. Other projects include a very simple air-to-air missile designated the Contraves C.7.

THE CONTRAVES C.7.

Flight tested initially as underwing armament on a North American F-86 Sabre interceptor of the Italian Air Force, the C.7 is an extremely simple air-to-air guided missile which is still in the development stage. It results from collaboration between Contraves and the official Centro Razzi (Rocket Centre).
TYPE.—Air-to-air guided weapon.
WINGS.—Cantilever low-wing monoplane type. Pivoted to work together or differentially for two-axis control. Each wing machined from solid light alloy. Two fences on upper surface of each wing.
BODY.—Cylindrical forebody attached to front of motor tube.
TAIL SURFACES.—Fixed cruciform tail surfaces at rear of motor tube.
POWER PLANT.—One solid-propellent sustainer.
GUIDANCE.—Passive (infra-red) homing, with detector behind glass dome in nose.
WARHEAD.—High-explosive.



The Contraves Italiana MTG-C1-56 surface-to-air missile.

DIMENSIONS (approx.).—
Length 2.40 m. (7 ft. 10½ in.).
Span of wings 0.45 m. (1 ft. 6 in.).
WEIGHT (approx.).—
Firing weight 54 kg. (120 lb.).
PERFORMANCE.—
No details available.

THE CONTRAVES MTG-C1-56

MTG-C1-56 is the designation given to the Italian-built version of the Swiss Oerlikon Type 56 surface-to-air guided missile, of which full details are given on page 407.

MISCELLANEOUS ITALIAN MISSILES.

AR.14. This is the designation of a small rocket test vehicle, with beam-riding guidance, which has undergone trials at the main Italian rocket testing base of Salto di Quirra, Sardinia. Its liquid-propellent (nitric acid and kerosene) motor produces 1,000 kg. (2,200 lb.) s.t. for 29 seconds, giving it an effective ceiling of 10,000 m. (32,000 ft.), which will be doubled in due course. The AR.14 is 7 m. (23 ft.) long and weighs about 500 kg. (1,100 lb.).

AR.15. Another liquid-propellent rocket that has been tested in Sardinia, the AR.15 is a development vehicle for a large surface-to-air guided weapon. It has been designed by Whitehead-Motofides of Leghorn.

MR.27. Well advanced in its operational testing, the MR.27 is a surface-to-air weapon, using radio command guidance and with an effective ceiling of 18,000 m. (60,000 ft.). It is 1.5 m. (4 ft. 11 in.) long and weighs 24 kg. (53 lb.). Its burn-out speed is reported to be 1,500 km.h. (930 m.p.h.), giving a range of up to 40 km. (25 miles).

JAPAN

FUJI

FUJI PRECISION COMPANY.

Fuji Precision Company are developing an air-to-air missile designated the TAAM-1D, of which brief details follow:

THE FUJI TAAM-1D.

A ground-launched firing test of this air-to-air missile was made successfully on a range at the foot of Mount Fuji, by the Japanese Defense Agency's Engineering Research Headquarters, on June 2, 1958.

The TAAM-1D is a slim tail-first missile, rather like the American Sidewinder in appearance. Photographs of the firing test show it on a zero-length launcher and fitted with a tandem booster rocket, but the latter is presumably used only for ground-launch tests. The missile is 2.6 m. (8 ft. 6 in.) long and weighs 153 kg. (337 lb.). Launched at an angle of 10°, it covered a distance of 2,500 m. (8,200 ft.), with an estimated speed of Mach 1.5 at burn-out. No warhead was fitted.

KAWASAKI

KAWASAKI KOKUKI KOGYO KABUSHIKI KAISHA (Kawasaki Aircraft Co. Ltd).

HEAD OFFICE: 100, KANINOSAKA, AKASHI.

In collaboration with six other companies, Kawasaki have been developing a small anti-tank guided weapon since the Autumn of 1956. No details are available except that the missile is 1.0 m. (3 ft. 3½ in.) in length.

MITSUBISHI

SHIN MITSUBISHI JUKOGYO KABUSHIKI KAISHA (Mitsubishi Heavy Industries, Reorganised, Ltd.).

HEAD OFFICE: No. 1 7-CHOME, WADAMIYA-DORI, HYOGO-KU, KOBE.

Officers: See "Aircraft" section.

The various Mitsubishi companies are playing a major rôle in the creation of a Japanese guided weapons industry. Mitsubishi Electrical Machinery Co. have a provisional licence to manufacture the Swiss Oerlikon Type 56 surface-to-air missile. Shin Mitsubishi are developing two air-to-air weapons under the designations of MM-1 and TMA-1; and Mitsubishi Shipbuilding and Engineering Company are working on the TLRM-1D surface-to-air missile system.

THE MITSUBISHI MM-1.

Under this designation, Mitsubishi are developing a small air-to-air weapon with a rocket motor by Fuji Precision Machinery and guidance by Mitsubishi Electrical Machinery. No details are available except that the MM-1 has a launching weight of 20 kg. (45 lb.).

THE MITSUBISHI TMA-1.

Larger than the MM-1, the Mitsubishi TMA-1 is an air-to-air guided weapon consisting of a fore-body 1.6 m. (5 ft. 3 in.) long, 0.15 m. (5.9 in.) in diameter and weighing 40 kg. (88 lb.), and an after-body 1.3 m. (4 ft. 3 in.) long with a weight of 70 kg. (154 lb.). Designed for a speed of Mach 1.6, it has met with little success in its initial air firing tests.

THE MITSUBISHI TLRM-1D.

Mitsubishi Shipbuilding and Engineering Company have a contract to build four TLRM-1D surface-to-air missiles, and the first of these was fired at a range near Mount Fuji on June 2, 1958. Launched at a 60° angle from a small mobile zero-length ramp, it covered 1,200 m. (3,940 ft.) at a speed of 410 km.h. (255 m.p.h.). No warhead was fitted.

The TLRM-1D is 3.3 m. (10 ft. 9½ in.) long and weighs 253 kg. (558 lb.). It has a liquid-propellent rocket motor.

UNIVERSITY OF TOKYO, INSTITUTE OF INDUSTRIAL SCIENCE.

Two types of sounding rocket, known as the K-150 and Kappa Type V, have been designed by Professor Hideo Itokawa of the University of Tokyo, for Japan's International Geophysical Year research programme. Available details of both rockets are given hereafter:

THE K-150.

The K-150 is a simple single-stage sounding rocket which was fired successfully for the first time on April 8, 1958. It has a slim cylindrical body, with pointed nose and fixed cruciform fins at the extreme tail. Power plant is a solid-propellent rocket motor, and it is ramp-launched from a simple mobile launcher.

DIMENSIONS.—
Length 3.3 m. (10 ft. 9½ in.).
Body diameter 150 mm. (5.90 in.).

WEIGHT.—
Firing weight 70 kg. (154 lb.).

THE KAPPA TYPE V.

Main tool of Japan's I.G.Y. rocket research programme, the Kappa Type V is a two-stage solid-propellent vehicle, in which the second stage consists of a K-150 rocket. It was fired successfully from a mobile launcher on April 29, 1958.

The booster is similar in configuration to the K-150, with fixed cruciform tail-fins, but has a body diameter of 220 m. (8.66 in.).

The Kappa Type V has a max. speed at burn-out of approx. Mach 3.4 and is designed to carry a 6.80 kg. (15 lb.) payload to a height of 130 km. (80 miles). Twenty rockets of this type were scheduled to be fired from the Akita test centre of Tokyo University, to measure air pressure, solar radiation, ion density, cosmic radiation, temperatures and winds.

SOVIET UNION

(The Union of Soviet Socialist Republics)



Surface-to-air missiles, possibly designated Type M-2.

Although U.S. sources have given provisional details of more than 20 different Soviet missiles, the only weapons on which reliable information is available are those which were displayed publicly in 1957, during the Moscow military parade to celebrate the 40th anniversary of the Russian Revolution.

They should not be regarded as representing the latest developments in Soviet missile design and production. Almost certainly the Red Army has an intermediate range ballistic missile in service, and this may well be the reported Model T-2 (M-103), a two-stage liquid-propellent weapon some 30 m. (100 ft.) long, with a firing weight of 55,000 kg. (122,000 lb.) and range of 2,900 km. (1,800 miles).

Russia's oft-discussed intercontinental ballistic missile is reported to be designated T-3 (M-104), and to be a three-stage weapon with the second and third stages consisting of modified T-1 and T-2 missiles. Test firings over ranges of up to 4,800 k.m. (3,000 miles) have been detected frequently by the U.S. radar "listening post" on Mount Samsun in Turkey, and adaptations of this weapon are said to have been used to launch Russia's I.G.Y. *Sputniks*.

SURFACE-TO-AIR MISSILE.

A two-stage surface-to-air guided weapon, since referred to in the United States as Type M-2, was exhibited in the 1957 military parade in Moscow and is believed to be a standard Soviet air defence missile.

It is similar to the U.S. Nike-Ajax in many design features and the two weapons are probably comparable in performance. Of particular interest is that the in-line booster is attached to the missile via a hollow casting, so designed that the sustainer can be fired simultaneously with the booster.

In the parade, missiles of this type were carried singly on articulated lorries of standard design, and it is probable that the rail on which each was mounted serves also as the launcher.

The following data are estimated.

TYPE.—Surface-to-air land-based guided weapon.
WINGS.—Fixed cruciform wings mounted well back on body.
BODY.—Cylindrical all-metal structure.
TAIL SURFACES.—Small movable cruciform tail surfaces at rear of weapon, indexed in line with wings.
POWER PLANT.—One liquid-propellent (?) sustainer. One in-line solid-propellent booster fitted with large cruciform fins indexed in line with wings. Sustainer and booster can be fired together.
GUIDANCE.—Probably a similar beam-riding/radar command system to that used in U.S. Nike-Ajax missile. This would explain cruciform blade aerials on nose-cone.
WARHEAD.—High-explosive.
DIMENSIONS (approx.).—
Length with booster 7.60 m. (25 ft.).
Body diameter 0.50 m. (1 ft. 8 in.).
Span of wings 2.0 m. (6 ft. 6½ in.).
WEIGHT (estimated).—
Firing weight, without booster 680 kg. (1,500 lb.).
PERFORMANCE (estimated).—
Speed at burn-out Mach 2.5.
Slant range 32 km. (20 miles).

SURFACE-TO-SURFACE MISSILES

Four types of surface-to-surface ballistic missile were shown in the 1957 Moscow parade. They are described hereafter in order of size, beginning with the smallest.

1. U.S. reported designation : T-5C.

Eight of these unguided spin-stabilised missiles appeared, each carried on a tracked vehicle based on the Type 1955 (JS.3) amphibious reconnaissance AFV chassis. This appears to serve also as the launcher.

TYPE.—Surface-to-surface unguided tactical weapon.
WINGS.—None.
BODY.—Bulbous-nose cylindrical all-metal structure.
TAIL SURFACES.—Fixed cruciform tail-fins at rear of missile.
POWER PLANT.—One solid-propellent sustainer. No booster.
GUIDANCE.—None. Spin-stabilised.
WARHEAD.—Probably choice of nuclear or high-explosive.
DIMENSIONS (approx.).
Length 7.60 m. (25 ft.).
Span of fins 0.90 m. (3 ft.).
WEIGHT (estimated).—
Firing weight 2,000 kg. (4,400 lb.).
PERFORMANCE (estimated).—
Range 16 km. (10 miles).

2. U.S. Reported designation : T-5B.

Soviet counterpart of the U.S. Honest John, this spin-stabilised unguided missile may be either a scaled-up version of the so-called Type T-5C, or an earlier model with less-advanced solid-propellent motor.

The eight missiles of this type which took part in the Moscow parade were carried on tracked vehicles somewhat larger than those used for the smaller rockets and with enclosed accommodation for the crew. In each case, the missile was covered by a heavy ribbed casing, which may provide some kind of heating to keep the propellent warm in low-temperature conditions.

TYPE.—Surface-to-surface unguided tactical weapon.
WINGS.—None.
BODY.—Bulbous-nose cylindrical all-metal structure.
TAIL SURFACES.—Fixed cruciform tail-fins at rear of missile.
POWER PLANT.—One solid-propellent sustainer. No booster.
GUIDANCE.—None. Spin-stabilised.
WARHEAD.—Probably choice of nuclear or high explosive.
DIMENSIONS (approx.).
Length 9.50 m. (31 ft.).
Span of fins 1.0 m. (3 ft. 3 in.).
WEIGHT (estimated).—
Firing weight 2,700 kg. (6,000 lb.).
PERFORMANCE (estimated).—
Range 24 km. (15 miles).



Surface-to-surface missile, reported to be Type T-5C.



Surface-to-surface missile, reported to be Type T-5B.



Surface-to-surface missile, reported to be Type T-7A.

3. U.S. Reported designation : T-7A.

Unlike the smaller bulbous-nose missiles, this weapon appears to have movable tail-fins, indicating some form of guidance. In the Moscow parade it was carried on a tracked vehicle identical with that used for the so-called Type T-5B, and almost certainly stands on its tail for launching.

TYPE.—Surface-to-surface guided weapon.
WINGS.—None.
BODY.—Cylindrical all-metal structure.
TAIL SURFACES.—Cruciform tail-fins, which appear to be movable, at rear of body.
POWER PLANT.—One liquid-propellent sustainer. No booster.
GUIDANCE.—Type unknown.
WARHEAD.—Probably choice of nuclear or high-explosive.
DIMENSIONS (approx.).—
Length 10.66 m. (35 ft.).
WEIGHT (estimated).—
Firing weight 4,500 kg. (10,000 lb.).
PERFORMANCE (estimated).—
Speed at burn-out Mach 5.
Range 80 km. (50 miles).

4. U.S. Reported designation : T-1 (M101).

Largest Soviet missile yet revealed in public, this weapon is believed to be based to a large extent on the wartime German V.2 rocket, incorporating improvements in structure and propellents. This would put it in much the same class as the American Redstone.

It was displayed in the Moscow parade on a mobile transporter, hauled by a tracked vehicle carrying its firing personnel.

TYPE.—Surface-to-surface guided weapon.
WINGS.—None.
BODY.—Cylindrical all-metal structure.
TAIL SURFACES.—Cruciform tail-fins at rear of body, with moveable elevators in trailing-edges and V.2-type control vanes positioned in rocket efflux.
POWER PLANT.—One liquid-propellent sustainer. No booster.
GUIDANCE.—Type unknown.
WARHEAD.—Probably choice of nuclear or high-explosive.
DIMENSIONS (approx.).—
Length 22.8 m. (75 ft.).
Span of fins 3.65 m. (12 ft.).
WEIGHT (estimated).—
Firing weight 20,500 kg. (45,000 lb.).
PERFORMANCE (estimated).—
Speed at burn-out Mach 6.5.
Range 725 kg. (450 miles).



Surface-to-surface missile, reported to be Type T-1.

SOVIET I.G.Y. RESEARCH SATELLITES.

No precise details have been given of the vehicles used to launch Russia's *Sputnik* Earth satellites into orbit. They are reported to have comprised an I.C.B.M. first stage, and second and third stages adapted from an I.R.B.M. and the medium range weapon referred to as Type T-1.

Following are brief details of the satellites themselves.

SPUTNIK I (1957-Alpha).

First Earth satellite ever established in orbit, on October 4, 1957, *Sputnik I* (I.G.Y. official designation 1957-Alpha) consisted of a polished metal sphere with a diameter of 0.58 m. (1 ft. 11 in.), weighing 83.6 kg. (184.3 lb.), and with a number of whip-type external aerials. Its instrumentation included radio telemetering equipment working on a frequency of 40 mc/sec., and devices for measuring the density and temperature of the atmosphere and the concentration of electrons in the ionosphere.

Sputnik I was put into an orbit with an initial apogee of 947 km. (588 miles) above the Earth and a perigee of 228 km. (142 miles). Its corresponding period of revolution around the Earth was 96.17 min. and it completed some 1,400 revolutions before it burned up in the atmosphere on January 4, 1958.

SPUTNIK II (1957-Beta).

Russia's second Earth satellite, established in orbit on November 3, 1957, comprised several groups of scientific instruments and a pressurised container for a test animal (the dog Laika) linked together by a light metal structure. Its purpose was to obtain data on the behaviour of a living organism in conditions of space flight and to measure cosmic radiation, in addition to the type of investigation already pioneered by *Sputnik I*.

Sputnik II weighed 508.3 kg. (1,120.6 lb.) and was put into an orbit with an initial apogee of 1,671 km. (1,038 miles) and perigee of 225 km. (140 miles). Its time to complete an orbit was 103.75 min. at that stage and it completed about 2,370 revolutions before being destroyed on April 14, 1958.

SPUTNIK III (1958-Delta).

Launched on May 15, 1958 and still in orbit at the time of writing, *Sputnik III* is in the form of a cone 1.73 m. (5 ft. 8 in.) in diameter at the base and 3.57 m. (11 ft. 7 in.) long, not including the protruding antennae. It weighs 1,327 kg. (2,926 lb.), of which 968 kg. (2,134 lb.) represents its payload of scientific instruments, radio equipment and sources of electric power, including externally-mounted solar batteries to recharge the batteries of its radio sets.

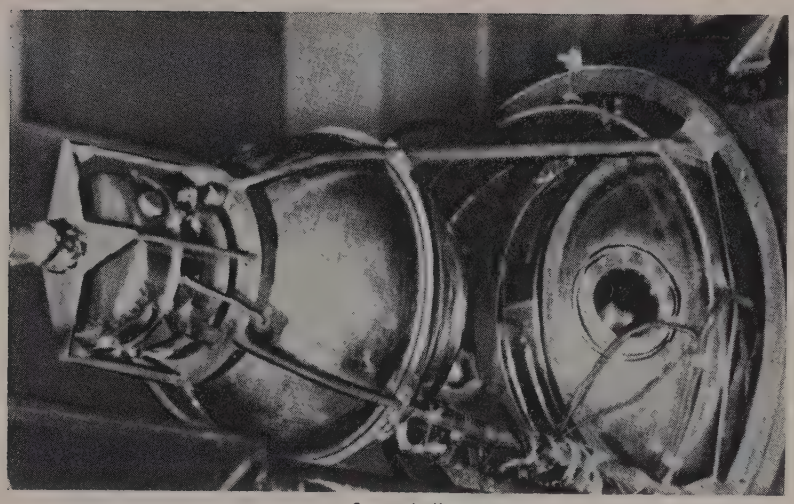
Instruments are installed in this satellite to study the pressure and composition of the upper layers of the atmosphere ; the concentration of positive ions ; the magnitudes of the electric charge of the *Sputnik*



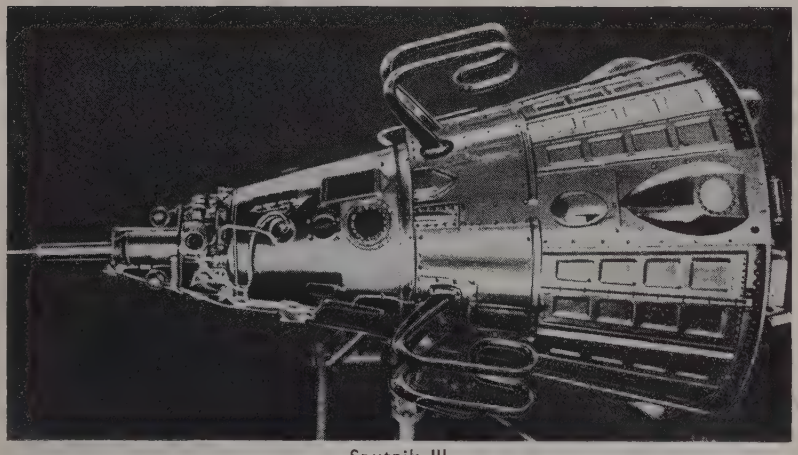
Sputnik I.

and the intensity of the Earth's electrostatic and magnetic fields; the intensity of solar radiation; the composition and variation of primary cosmic radiation; the distribution of the photons and heavy nuclei in cosmic rays; the size and number of micrometeors; and the temperatures inside the *Sputnik* and on its surface.

Sputnik III was orbited, like its predecessors, at an angle of 65° to the Equator and was detached from its carrier rocket at a speed of over 28,800 km.h. (17,900 m.p.h.). Its orbit had an initial apogee of 1,880 km. (1,168 miles) and a complete revolution took 105 min. 57 sec. By July 27, 1958, it had completed 1,000 revolutions and was still telemetering data.



Sputnik II.



Sputnik III.

SWEDEN

ROBOTBYRAN

(Swedish Guided Weapons Bureau).

A series of guided weapons is being developed by the Robotbyrån (Guided Weapons Bureau), which is part of the Royal Swedish Air Board, in collaboration with F.O.A. (The Swedish Armed Forces' Research Establishment) and other official and commercial organisations.

Of these, the Robot 304 air-to-surface missile and the Robot 315 surface-to-surface missile can be described in detail. Still secret are a surface-to-air weapon and an air-to-air missile intended as primary armament of the Saab J-35 fighter.

THE ROBOT 304.

In production as armament for the Saab J-32 Lansen attack aircraft, the Robot 304 is an all-weather powered bomb intended for use against targets at sea.

It was developed to a 1949 specification, after firing tests of an earlier experimental missile, designated the type 302, had been made in the previous year from a Saab T.18B piston-engined bomber. Project work on the 304 began in March 1950 and the first full-scale airframe was flight tested in the spring of 1954. The first complete Robot 304 was fired from a Saab J-29 fighter in February 1955 and subsequent development has been very successful.

TYPE.—Air-to-surface guided weapon.
WINGS.—Mid-wing cantilever monoplane, mounted at rear of weapon. Ailerons in trailing-edges. Fixed fins at tips.
BODY.—Circular-section all-metal structure.
TAIL SURFACES.—Tail-first design. Cruciform control surfaces on nose. Fixed fins at wing-tips.
POWER PLANT.—One solid-propellent sustainer. No booster.
GUIDANCE.—Radio command from launching aircraft.
WARHEAD.—High-explosive.
DIMENSIONS (approx.).
Length 4.40 m. (14 ft. 6 in.).
Span of wings 2.0 m. (6 ft. 6 in.).
WEIGHT (estimated).—
Launching weight 450 kg. (1,000 lb.).
PERFORMANCE (estimated).—
Speed Mach 0.95.
Range 4,500 m. (2.8 miles).



The Robot 304.

THE ROBOT 315.

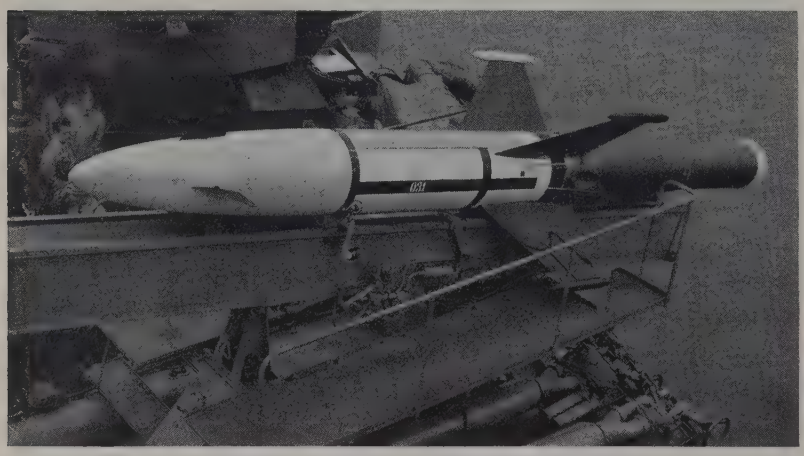
Robot 315 is a surface-to-surface missile for use from naval destroyers against targets at sea, and is operational on board the *Halland* and *Smaland* of the Royal Swedish Navy.

The naval requirements that led to its design were formulated in 1946, but project work did not start until January 1949, and subsequent development has been complicated by the unique dual power plant, comprising a pulsejet sustainer and built-in rocket boosters.

The airframe was first tested in July 1953, and the first complete missile was fired in January 1954 from the test station at Karlsborg on the shore of Lake Vaettern. The initial firing from the destroyer *Halland* took place in April, 1955, and it is now in production at the Air Force Central Workshops, with the assistance of civilian sub-contractors.

Robot 315 is an all-weather weapon, with a range considerably greater than that of the conventional guns of a destroyer. It is launched from a lengthy ramp.

TYPE.—Surface-to-surface ship-based guided weapon.
WINGS.—Fixed cruciform wings placed well back on body. Tracking flare on each wing-tip.
BODY.—Cylindrical all-metal structure.
TAIL SURFACES.—Tail-first design. Cruciform control surfaces on nose, indexed at 45° to wings.
POWER PLANT.—Pulsejet sustainer in body, with tail-pipe aft of wings. Four solid-propellent boosters built into body, with nozzles immediately aft of wings. Intake grilles for pulsejet forward of rocket nozzles.
GUIDANCE.—No details available.
WARHEAD. High-explosive.
DIMENSIONS (approx.).—
Length 6.70 m. (22 ft.).
Span of wings 2.45 m. (8 ft.).
WEIGHT (estimated).—
Firing weight over 1,360 kg. (3,000 lb.).
PERFORMANCE (estimated).—
Speed Mach 0.85.



The Robot 315 surface-to-surface guided weapon.

SWITZERLAND

CONTRAVES-OERLIKON

CONTRAVES, LTD.

OERLIKON MACHINE TOOL WORKS, BÜHRLE & CO.

ARMAMENT DIVISION: ZURICH.

For more than a decade the Contraves and Oerlikon companies have been collaborating in the design and development of guided missiles on a private venture basis. Their first major product was the Type 54 liquid-propellent (1,000 kg. = 2,200 lb. s.t.) surface-to-air weapon.

The Type 56, which is now available "off the shelf" as a fully developed weapon system, is an improved version of the Type 54, with the same dimensions. It is being produced in Italy by Contraves Italiana, as the MTG-C1-56, and is a standard training weapon at the Italian Air Force firing range of Salto di Quirra, Sardinia.

Also under development is a small surface-to-surface tactical missile known as the Cobra.

THE C.O.B. COBRA IV.

This simple wire-guided anti-tank missile is the latest of a series of weapons



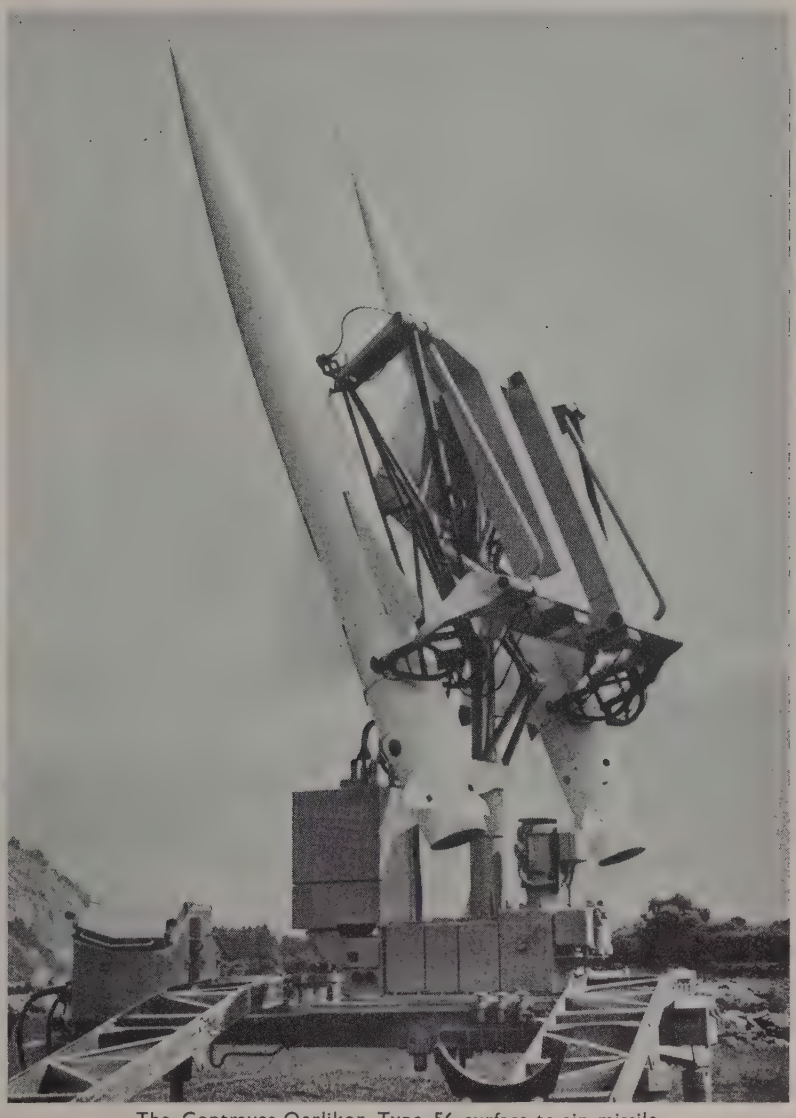
The C.O.B. Cobra IV.

of this type which Contraves and Oerlikon have been developing since 1946. Produced jointly by this group and the German Bölkow company, it was expected to complete its pre-production testing during 1958.

TYPE.—Surface-to-surface tactical guided weapon.
WINGS.—Cruciform fixed wings at rear of body each with a small control surface inset in the trailing-edge.
BODY.—Cylindrical metal structure.
TAIL SURFACES.—None.
POWER PLANT.—One solid-propellent sustainer. No booster.
GUIDANCE.—Wire command type.
WARHEAD.—High-explosive.
DIMENSIONS (approx.).—
Length 0.85 m. (2 ft. 10 in.).
Span of wings 0.75 m. (2 ft. 6 in.).
WEIGHT (estimated).—
Firing weight 11 kg. (24 lb.).
PERFORMANCE (estimated).—
Speed 290 km.h. (180 m.p.h.).
Max. range 1,370 m. (4,500 ft.).

THE CONTRAVES-OERLIKON TYPE 56.

The Type 56 surface-to-air guided weapon is available either in operational form or as a training missile with a parachute recovery system instead of the normal warhead and proximity fuse.



The Contraves-Oerlikon Type 56 surface-to-air missile.

It is fired from a twin launcher and a typical anti-aircraft battery comprises six launchers. Each battery has a target-tracking radar, which controls the beam along which the missile travels to its target. Maximum rate of fire from such a battery is 12 rounds per minute. Launching is possible at any angle between 20° and 90°.

TYPE.—Surface-to-air land-based guided weapon.
WINGS.—Cruciform wings of delta planform positioned well back on body. Wings are of sandwich construction and are so mounted that they slide axially to compensate for changes of trim in flight.
BODY.—Cylindrical light-alloy structure, bonded together.
TAIL SURFACES.—Cruciform control surfaces at rear of body, indexed at 45° to wings.
POWER PLANT.—One liquid-propellent sustainer. No booster. Propellents are nitric acid and kerosene, fed into chamber by nitrogen pressure. Chamber is gimbal-mounted to provide control at low speeds.
GUIDANCE.—Beam-riding.
WARHEAD.—40 kg. (88 lb.) of high-explosive, with proximity fuse.
DIMENSIONS.
Length 6.10 m. (20 ft.).
Body diameter 0.40 m. (1 ft. 4 in.).
Span of wings 1.37 m. (4 ft. 6 in.).
WEIGHT.—Firing weight 370 kg. (820 lb.).
PERFORMANCE.—
Speed at burn-out Mach 2.4.
Operational altitude 3,000-20,000 m. (10,000-66,000 ft.).

UNITED STATES OF AMERICA

AEROJET



The Aerojet Aerobee-Hi Model 150.

AEROJET GENERAL CORPORATION.

HEAD OFFICE: 6352, N. IRWINDALE AVENUE, AZUSA, CALIFORNIA.

Officers: See "Gas-turbines" section.

Aerojet Aerobee upper atmosphere research rockets have been used widely for many years, and on April 30, 1957, an Aerobee-Hi reached an altitude of 193 miles (311 km.), carrying a 128 lb. (58 kg.) payload. Many more are being fired from an arctic launching facility built by Aerojet engineers at Fort Churchill on Hudson's Bay, Canada, during the International Geophysical Year programme.

Aerobee rockets are launched from a 140 ft. (43 m.) tall tower structure and their payload has often included mice and monkeys, which have been recovered safely from altitudes up to 40 miles (65 km.). Details of the current versions are given hereafter.

THE AEROJET AEROBEE MODEL 75.

TYPE.—Single-stage research rocket.
WINGS.—None.
BODY.—Cylindrical structure. Aluminium nose section containing payload. Central power plant section with heat-treated steel case. Magnesium tail section.
TAIL SURFACES.—Three aluminium fins equi-spaced around rear of body.
POWER PLANT.—One solid-propellent integral booster and sustainer.
PAYLOAD.—75-150 lb. (34-68 kg.).
DIMENSIONS.—
Length 16 ft. 10 in. (5.13 m.).
Body diameter 1 ft. 2 in. (0.36 m.).
WEIGHT.—
Firing weight, less payload 900 lb. (408 kg.).
PERFORMANCE.—
Ceiling with 100 lb. (45 kg.) payload 75 miles (120 km.).

THE AEROJET AEROBEE MODEL 100.

TYPE.—Two-stage high-altitude research rocket.
WINGS.—None.
BODY.—Similar construction to Model 75.
TAIL SURFACES.—Similar to Model 75.
POWER PLANT.—Liquid-propellent gas-pressurised sustainer. Aerojet type 2.5KS-18000 solid-propellent booster in tandem.
PAYLOAD.—40-150 lb. (18-68 kg.).
DIMENSIONS.—
Length without booster 19 ft. 3 in. (5.87 m.).
Body diameter 1 ft. 3 in. (0.38 m.).
WEIGHT.—
Firing weight, with booster, less payload 1,405 lb. (637 kg.).
PERFORMANCE.—
Ceiling with 40 lb. (18 kg.) payload 100 miles (160 km.).

THE AEROJET AEROBEE-HI MODEL 150.

TYPE.—Two-stage high-altitude research rocket.
WINGS.—None.
BODY.—Cylindrical structure. Aluminium nose section containing payload. Optional magnesium extension sections. Propellent tankage section of heat-treated stainless steel. Magnesium tail section.
TAIL SURFACES.—Three fins equi-spaced around rear of body.
POWER PLANT.—One liquid-propellent gas-pressurised sustainer. One Aerojet type 2.5KS-18000 solid-propellent booster in tandem.
PAYLOAD.—120-280 lb. (54-127 kg.).
DIMENSIONS.—
Length, less booster and extensions 23 ft. 7 in. (7.19 m.).
Body diameter 1 ft. 3 in. (0.38 m.).
WEIGHT.—
Firing weight, with booster, less payload 1,941 lb. (880 kg.).
PERFORMANCE.—
Ceiling with 150 lb. (68 kg.) payload 165 miles (265 km.).

AEROPHYSICS

AEROPHYSICS DEVELOPMENT CORPORATION.

HEAD OFFICE: P.O. BOX 689, SANTA BARBARA, CALIFORNIA.

President: Dr. William Bollay.

Aerophysics Development Corporation, a subsidiary of Curtiss-Wright Corporation, have developed an anti-tank missile named the Dart, which is in production for the U.S. Army. Another of their products is a hypersonic test vehicle intended to explore aerodynamic, structural and heat-transfer problems at speeds up to more than 7,000 ft./sec. (2,150 m./sec.), or 4,775 m.p.h. (7,685 km.h.). Both missiles are described below.



The Aerophysics Dart on a Jeep launcher.

THE AEROPHYSICS DART.

U.S. Army designation : SSM-A-23.

This anti-tank wire-guided weapon was a joint development of the U.S. Army Ordnance District, Los Angeles; Redstone Arsenal, Huntsville, Alabama; and Aerophysics Development Corporation. It is in production for the U.S. Army at the Utica-Bend plant of the Curtiss-Wright Corporation.

Already in service, it is launched from a zero-length ramp, mounted usually on a standard M59 truck and is guided visually to the target with the aid of an optical tracking system. In trials, the Dart has been guided into 6 ft. (1.83 m.) targets at ranges of over one mile (1.6 km.).

TYPE.—Surface-to-surface tactical guided weapon.
WINGS.—Fixed cruciform wings of aerofoil section mounted well back on body, each with aileron inset in trailing-edge, small wing-tip spoiler and fixed end-plate.
BODY.—Cylindrical metal structure.
TAIL SURFACES.—Fixed cruciform fins at rear of body, indexed at 45° to wings.
POWER PLANT.—One Grand Central solid-propellent sustainer. No booster.
GUIDANCE.—H. A. Wagner optical tracking system. Initial guidance by simple gyroscopic gravity-correction system actuating ailerons. Optical tracking system actuates wing-tip spoilers.
WARHEAD.—High-explosive shaped-charge warhead.
DIMENSIONS (approx.).—
Length 5 ft. (1.52 m.).
Span of wings 4 ft. 2 in. (1.27 m.).
Span of fins 3 ft. (0.91 m.).

WEIGHT (estimated).—
Firing weight 100 lb. (45 kg.).
PERFORMANCE (estimated).—
Speed Mach 0.95.
Range 6,000 ft. (1,830 m.).

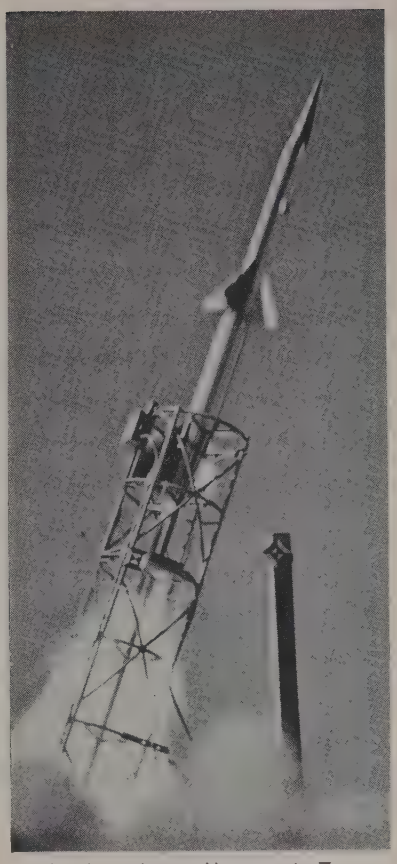
THE AEROPHYSICS HYPERSONIC TEST VEHICLE.

Initiated as a design study in 1952, the Aerophysics hypersonic test vehicle is a two-stage research rocket, able to attain speeds of more than 7,000 ft./sec. (2,150 m./sec.) within two seconds of firing.

The first-stage booster consists of a cluster of seven solid-propellent rocket motors and is fitted with three fiberglas stabilising fins. The second stage comprises four Wasp 1 solid-propellent rocket motors and has four fiberglas fins. The 2 ft. (0.60 m.) nose-cone has a base diameter of approx. 7 in. (0.18 m.) and can be made from a variety of materials and in a wide range of shapes according to the research data required. It contains a 2 lb. (1 kg.) eight-channel magnetic tape recorder to record automatically acceleration and temperatures and pressures for flights of up to eight minutes duration.

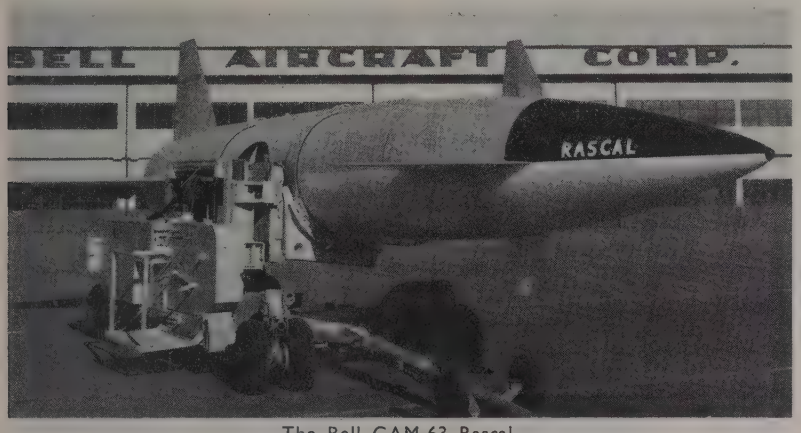
In operation, the HTV is fired from a 16 ft. (4.9 m.) long portable launcher. All seven of the first-stage rockets are ignited simultaneously and this stage falls away when they are burned out, automatically igniting the second-stage rockets. About six seconds after the second-stage has burned out, its fins are blown off by small explosive charges. This causes the rocket to lose its stability and tumble to the ground at about 100 m.p.h. (160 km.h.) for recovery.

The complete HTV is about 13 ft. (4 m.) long and weighs approximately 231 lb. (105 kg.).



The Aerophysics Hypersonic Test Vehicle

BELL



The Bell GAM-63 Rascal.

BELL AIRCRAFT CORPORATION.

HEAD OFFICE AND WORKS: P.O. Box 1, BUFFALO 5, NEW YORK.
SPECIAL WEAPONS DIVISION.

General Manager: Glenn L. Lord.

Bell's major missile project since 1946 has been the development of an air-to-surface stand-off bomb, and the company has had overall responsibility since 1952 for the programme that has produced the GAM-63 (originally XB-63) Rascal missile. This weapon reached squadron status in 1957, the first production round being accepted at Pinecastle Air Force Base, Florida, on October 30, 1957. Rascal is carried only by DB-47 Stratojet bombers, on an outrigger pylon mounted on the starboard side of the aircraft's fuselage, under the wing root.

Bell is also a member of the Martin Aircraft team that is producing one of the two competitive design studies for the U.S.A.F.'s Dyna-Soar rocket-boosted glider project.

THE RASCAL.
U.S.A.F. designation: GAM-63.

This rocket-powered air-to-surface guided weapon is now operational with DB-47E Stratojet squadrons of the U.S.A.F.'s Strategic Air Command. First stand-off bomb to reach squadron status, it is intended to avoid the necessity for aircrews in the launching aircraft to fly within range of the close defences of their target.

Just previous to formal acceptance of the first production Rascal in the autumn of 1957, test models scored four consecutive direct hits on targets at the Air Force Missile Development Center in New Mexico. Distance from launch to target was not disclosed. Target diameter was 3,000 ft. (915 m.).

TYPE.—Air-to-surface guided weapon.
WINGS.—Cantilever mid-wing monoplane, mounted at rear of body. Aluminium construction. Full-span trailing-edge ailerons.
BODY.—All-metal structure.
TAIL SURFACES.—Tail-first design. Fixed fore-plane fitted with elevators. Upper and lower movable rudders at nose. Upper and lower tail-fins, the lower one folding sideways to provide ground clearance whilst on loading trolley and on aircraft before take-off.
POWER PLANT.—One Bell liquid-propellent rocket motor, made up of three vertical in-line chambers, each with a thrust of 4,000 lb. (1,815 kg.). Chambers can be operated individually or together. Liquid oxygen and alcohol propellents contained in tanks in body.
GUIDANCE.—Initially, guidance is by a radar command system developed jointly by Bell Avionics, Radio Corporation of America and Texas Instruments. Later rounds are reported to have an inertial system by Bell and Federal Telecommunications Laboratories.
WARHEAD.—Atomic or thermonuclear, as required.
DIMENSIONS.—
Length 32 ft. (9.75 m.).
Body diameter 4 ft. (1.22 m.).
Span of wings approx. 14 ft. (4.27 m.).
WEIGHT.—
Launching weight 13,000 lb. (5,900 kg.).
PERFORMANCE (estimated).—
Cruising speed Mach 1.6.
Max. range 100 miles (160 km.).



The Bell GAM-63 Rascal in position on a Boeing YDB-47B bomber.

BENDIX

BENDIX AVIATION CORPORATION.

HEAD OFFICE: FISHER BUILDING, DETROIT 2, MICHIGAN.

President: M. P. Ferguson.

In addition to being prime contractors for the highly-successful Talos weapon, Bendix are responsible for the guidance system of the forthcoming Pershing solid-propellent ballistic missile. They are also a member of the Martin Aircraft team that is producing one of the two competitive design studios for the U.S.A.F.'s Dyna-Soar rocket-boosted glider project.

THE TALOS.

U.S. Navy designation: SAM-N-6.
U.S.A.F. designation: IM-70 Talos L.
U.S. Army designation: Talos W.

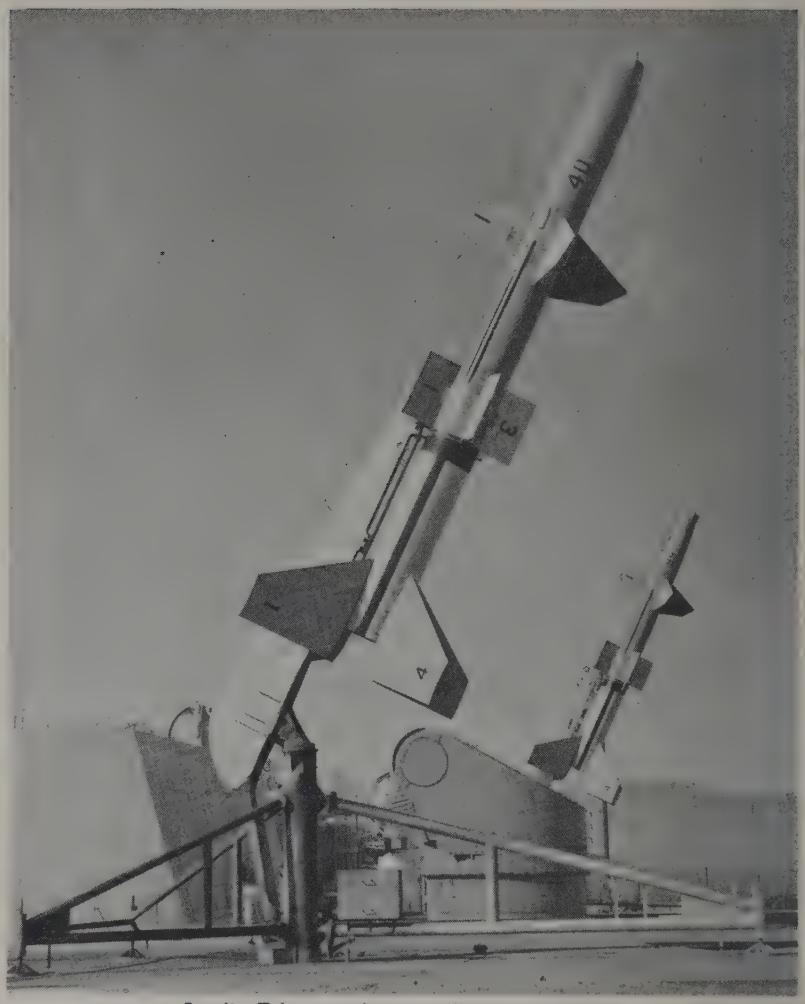
Like the Convair Terrier, Talos results from the Bumblebee research programme, initiated by the Applied Physics Laboratory of Johns Hopkins University, in 1945. Bendix are the prime contractors, with McDonnell responsible for the bulk of the airframe.

Talos is basically a beam rider, but has a semi-active homing head, giving increased accuracy in the final stages of interception. Sperry supply the SPG-49 "lamp" radar installation for this.

First U.S. Navy vessel to deploy Talos operationally is the U.S.S. *Galveston*, a light cruiser. Two other light cruisers will be Talos-armed, as will the nuclear cruiser *Long Beach*, for which a special General Electric handling and launching system is being developed. This will incorporate an electronic computing centre, so that the fire controller will be able to select either a nuclear or high-explosive Talos from below-deck stores, have it extracted, raised to the launchers and fired automatically.

Talos is also under evaluation by the U.S. Army and U.S.A.F., the shore installation offering similar automatic loading and firing facilities.

TYPE.—Surface-to-air guided weapon.
WINGS.—Pivoted cruciform wings mounted at mid-point on body.
BODY.—Cylindrical all-metal structure, mainly of steel.
TAIL SURFACES.—Fixed cruciform fins of rectangular planform mounted at rear of body and indexed in line with the wings.
POWER PLANT.—Two-stage in tandem. One McDonnell 18 in. (460 mm.) ramjet sustainer, burning kerosene fuel. Allegany Ballistics or Bendix solid-propellent booster, fitted with large cruciform stabilising fins, indexed in line with wings.
GUIDANCE.—Initial beam-riding, with semi-active homing, by Sperry.
WARHEAD.—Choice of nuclear or high-explosive.
DIMENSIONS (approx.).—
Length with booster 31 ft. 3 in. (9.53 m.).
Body diameter 2 ft. 6 in. (0.76 m.).
Span of wings 9 ft. 6 in. (2.90 m.).
WEIGHT (estimated).—
Firing weight without booster 3,000 lb. (1,360 kg.).
PERFORMANCE (estimated).—
Speed at burn-out above Mach 3.
Slant range 30-65 miles (48-105 km.).



Bendix Talos missiles at a shore test station.

BOEING

THE BOEING AIRPLANE COMPANY.

HEAD OFFICE AND WORKS: SEATTLE, WASHINGTON.

PILOTLESS AIRCRAFT DIVISION.

Officers: See "Aircraft" Section.

After gaining considerable experience since 1945 in the development and testing of surface-to-air test vehicles, under their GAPA (Ground-to-Air Pilotless Aircraft) programme, Boeing began work in 1949 on an operational pilotless interceptor missile for the U.S.A.F., under the designation of XF-99.

Subsequently redesignated IM-99 and named Bomarc, this weapon was tested in prototype form in 1952 and several dozen YIM-99 development rounds have since been fired from Patrick Air Force Base, Florida. A spectacular success was achieved in October 1957, when one of these missiles climbed to 60,000 ft. (18,300 m.), tracked down a QB-17 drone target aircraft over 100 miles (160 km.) away, dived on it and destroyed it by ramming, although carrying no warhead.

Bomarc is now entering service with the U.S.A.F. and advanced versions are under development. It will also form part of the Canadian air defence system.

Boeing are also engaged on a substantial research project to perfect an anti-ICBM weapons system in collaboration with other companies, and head one of the two teams which are producing competitive design studies for the U.S.A.F.'s Dyna-Soar rocket-boosted glider project.

THE DYNA-SOAR.

The U.S.A.F. announced in mid-1958 that contracts had been awarded to two competitive teams of companies to produce design studies for a piloted rocket-boosted glider to be known as the Dyna-Soar (Dynamic-Soaring). One of these teams, under the overall direction of Boeing, comprises the Missile and Autonetics Divisions of North American Aviation; the Architectural and Engineering Division and the Boost Rocket Division of Aerojet-General Corporation; Chance Vought Aircraft; General Electric Company; Ramo-Wooldridge Corporation; Avionics and Electronics Division of Goodyear Aircraft Corporation; and the Radio Corporation of America.

Dyna-Soar is described as a piloted glider that will be boosted to a height of several hundred miles by jettisonable rocket-motors and will then soar around the earth for very great distances at near-satellite speeds. It will be a winged aircraft, able to land in the conventional manner at the end of its flight.

In its military form, the Dyna-Soar is visualised as a reconnaissance vehicle, able to encircle the earth one or more times, with potential development into a strategic bomber.

THE BOMARC.

U.S.A.F. designation: IM-99.

Only long-range surface-to-air missile yet announced anywhere in the world, Bomarc is a true pilotless interceptor in configuration and rôle.

It is launched vertically, initial propulsion being by means of an internal rocket. Cruising propulsion is provided by two large ramjets carried on pylons under its body. Its Westinghouse guidance system works in conjunction with the SAGE (semi-automatic ground environment) electronic computing network into which are integrated all modern U.S. land-based interceptor aircraft and surface-to-air missiles.

Variants of Bomarc announced to date are:

XF-99.—Initial prototypes, first tested in 1952.

YIM-99.—Development missiles tested at Patrick A.F.B.

IM-99A.—Initial production version with Marquardt RJ43 ramjets. Details below refer to this type.

IM-99B.—Announced in February 1958. Improved version with more powerful Marquardt XRJ59 ramjets. Aerojet solid-propellent jettisonable internal booster, instead of non-jettisonable liquid-propellent booster of IM-99A. Range increased to approx. 400 miles (645 km). Under development.

TYPE.—Surface-to-air land-based guided weapon.

WINGS.—Cantilever shoulder-wing monoplane, mounted well back on body. 50° sweepback. Thickness/chord ratio approximately 3%. Entire outer panels pivoted to act as ailerons.

BODY.—All-metal structure.

TAIL SURFACES.—Cantilever monoplane type. Tip of fin and virtually all of horizontal tailplane are pivoted for control purposes.

POWER PLANT.—Two Marquardt RJ43-MA-3 ramjet engines, each giving 11,500 lb. (5,220 kg.) s.t. mounted on pylons under body. Kerosene tanks in centre-body. Aerojet-General liquid-propellent (nitric acid and kerosene) booster, giving 35,000 lb. (15,875 kg.) s.t., in tail.

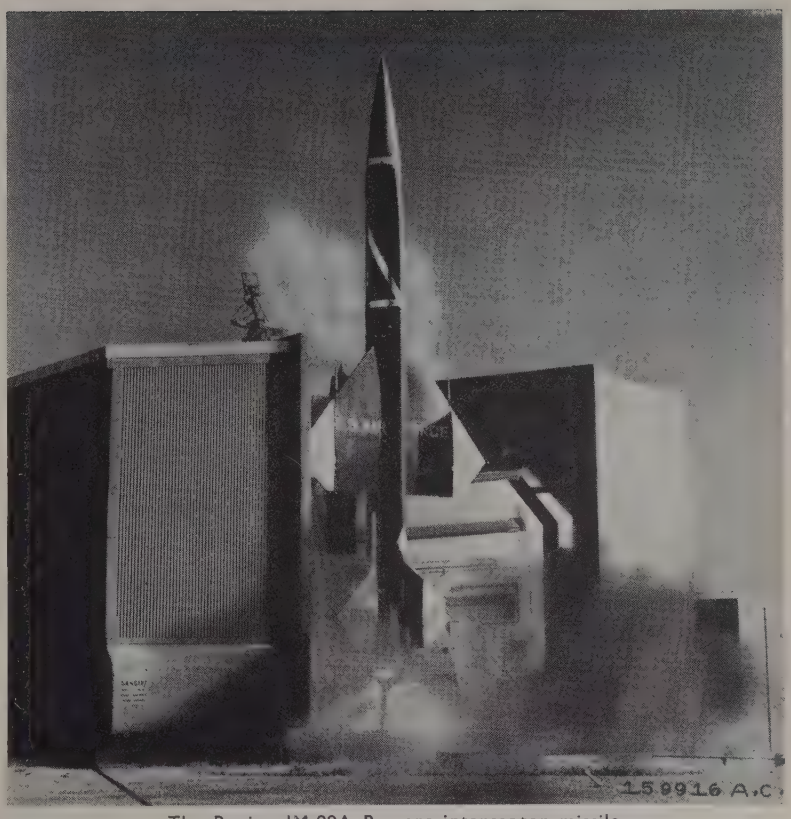
GUIDANCE.—Western Electronics radar guidance, linked to SAGE network, with Westinghouse active homing system for final stage of interception. Latter installation mounted in Patushin Fiberglas nose-cone.

WARHEAD.—Nuclear or high-explosive, as required.

DIMENSIONS.—
Length 46 ft. 8 in. (14.22 m.).
Body diameter 3 ft. (0.91 m.).
Span of wings 18 ft. 2 in. (5.54 m.).

WEIGHT (estimated).—
Launching weight 15,000 lb. (6,800 kg.).

PERFORMANCE.—
Cruising speed Mach 2.8.
Range 200 miles (320 km.).



The Boeing IM-99A Bomarc interceptor missile.

CHANCE VOUGHT

CHANCE VOUGHT AIRCRAFT INC.

HEAD OFFICE AND WORKS: DALLAS, TEXAS.

Officers: See "Aircraft" section.

Chance Vought received their first U.S. Navy missile development contract in 1947, when they began the design of a very simple medium-range surface-to-surface weapon for operation from all types of naval vessels, including submarines. This weapon has been in operational service with the fleet since 1955, as the SSM-N-8 Regulus 1. A sweptwing supersonic missile designated SSM-N-9 Regulus 2 is now in production to supersede it.

In addition to this work for the U.S. Navy, Chance Vought is a member of the Boeing team which is producing a competitive design study for the U.S.A.F.'s Dyna-Soar rocket-boosted glider project.

THE REGULUS 1.

U.S. Navy designation: SSM-N-8.

Designed to meet a 1947 U.S. Navy requirement for a simple subsonic "flying bomb" type missile capable of being launched from a submarine, the Regulus 1 first flew in 1951 and has been in service with the fleet since 1955. It was due to phase out of production during 1958.

To speed development and reduce costs, many of the early missiles were recovered at the end of flight trials with the aid of a retractable landing gear and braking parachute, which enabled them to complete an average of six flights each. This type of recoverable Regulus 1 continues in service as a training missile, equipped usually with drone-type radio command guidance, with the controller either on the ground or in an aircraft. A target drone version is also in service.

The operational Regulus 1 can be trolley-launched from aircraft carriers or ramp-launched from other vessels. By the beginning of 1957, ten carriers, four cruisers and the submarines *Barbero* and *Tunny* were carrying the Regulus 1. Other submarines are equipped to guide but not to launch the missile.

TYPE.—Surface-to-surface guided weapon.

WINGS.—Cantilever mid-wing monoplane. Sweptback wings. Outer panels fold inward for stowage on board ship and in submarine deck hangars.

BODY.—Cylindrical structure, making extensive use of light alloy/balsa sandwich.

TAIL SURFACE.—Vertical fin only.

POWER PLANT.—One 4,600 lb. (2,085 kg.) s.t. Allison J33-A-14 turbojet sustainer in body. Two 33,000 lb. (15,000 kg.) Aerojet-General solid-propellent boosters attached to sides of rear fuselage.

GUIDANCE.—Command guidance.

WARHEAD.—Nuclear type.

DIMENSIONS.—
Length 33 ft. (10.06 m.).
Body diameter 4 ft 6 in. (1.37 m.).
Span of wings 21 ft. (6.40 m.).

WEIGHT.—
Launching weight 14,522 lb. (6,587 kg.).

PERFORMANCE (approx.).—
Max. speed transonic in terminal dive
Cruising speed Mach 0.87.
Range 575 miles (925 km.).



The Chance Vought SSM-N-8 Regulus 1.

THE REGULUS 2.

U.S. Navy designation: SSM-N-9.

Despite its name, Regulus 2 is an entirely new design, with supersonic capabilities and a range double that of Regulus 1. Its use from the submarines *Grayback* and *Growler*, each of which carries two missiles in streamlined deck hangers, gives the U.S. Navy a weapon with the effective range of a land-based ICBM. Other submarines designed to carry Regulus 2 include the forthcoming nuclear-powered *Halibut*.

Early models, of which the first flew on May 29, 1956, were powered by a Curtiss-Wright J65 turbojet engine (7,800 lb.=3,500 kg. s.t.) and were fitted with a



The Chance Vought SSM-N-9 Regulus 2.

retractable nosewheel landing gear and braking parachute to make possible their recovery and re-use. Production versions have a General Electric J79 turbojet. By the end of 1957, 23 flights had been made by Regulus 2, and it entered service in 1958.

TYPE.—Surface-to-surface guided weapon.

WINGS.—Cantilever mid-wing monoplane. Sweptback wings, built up mainly of large single sheets of tapering thickness. Inset elevons in trailing-edges.

BODY.—All-metal structure, with under-fuselage inclined-shock intake formed from a single magnesium casting.

TAIL SURFACES.—Tail-first design. Fixed fore-planes on nose. Fixed fin and movable rudder at rear.

POWER PLANT.—One General Electric J79 turbojet sustainer, with afterburner. One 115,000 lb. (52,165 kg.) s.t. Aerojet-General solid-propellent booster attached under body.

GUIDANCE.—A.C. Spark Plug inertial guidance.

WARHEAD.—Nuclear type.

DIMENSIONS.—
Length 57 ft. (17.37 m.).
Body diameter 6 ft. (1.83 m.).
Span of wings 20 ft. (6.10 m.).

WEIGHT.—
Launching weight, without booster, 23,000 lb. (10,435 kg.).

PERFORMANCE.—
Cruising speed Mach 2.
Range more than 1,150 miles (1,850 km.) at over 60,000 ft. (18,300 m.).

CHRYSLER

CHRYSLER CORPORATION.

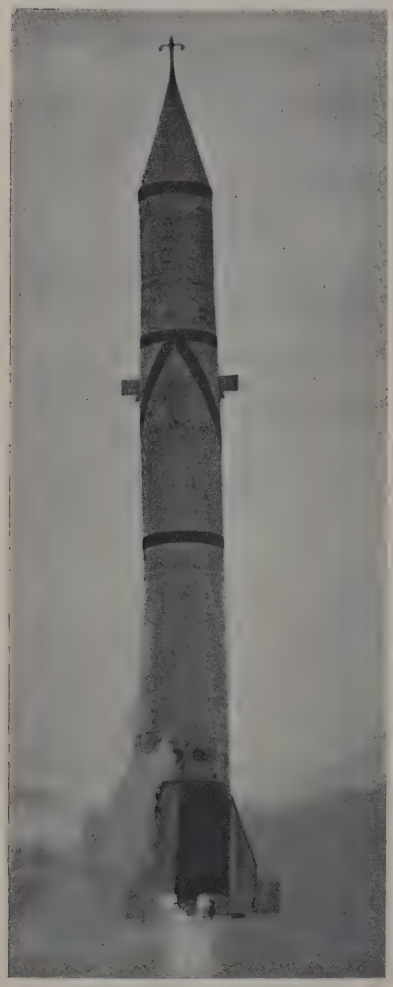
HEAD OFFICE: 341, MASSACHUSETTS AVENUE, HIGHLAND PARK, MICH.

MISSILE DIVISION: 6230 JOHN R. STREET DETROIT 31, MICH.

President: L. L. Colbert.

Group Executive, Defense: Irving J. Minett.

This famous automobile manufacturing company has been given responsibility for production of the Redstone and Jupiter missiles designed at the U.S. Army Ballistic Missile Agency, Redstone Arsenal, Alabama, under the leadership of Dr. Wernher von Braun, designer of the wartime German V.2 rocket.



The SSM-A-14 Redstone.

Production of the fully-operational Redstone is centred in the former U.S. Navy plant at Warren, near Detroit. About 1,675 sub-contractors contribute to the programme, including Reynolds Metal Co., who manufacture the bulk of the airframe.

THE REDSTONE.
U.S. Army designation: SSM-A-14.

Redstone is basically an improved V.2 bombardment missile and was the largest guided weapon in service outside Russia in mid-1958. It was first fired in prototype form in May 1953, and the 40th Field Artillery Missile Group began training in handling the weapon, at Redstone Arsenal, three years later. Other U.S. Army units have followed, each battalion comprising 600 men, formed into batteries, each with a single launcher and nine support vehicles.

Major change compared with V.2 is that the entire propulsion system is jettisoned after burn-out, leaving the nose portion, containing guidance and warhead, to continue on a ballistic trajectory.

TYPE.—Surface-to-surface guided missile.

WINGS.—None.

BODY.—Cylindrical all-metal structure of wrapped aluminium, made in four sections and bolted together.

TAIL SURFACES.—Cruciform tail-fins with movable rudders and refractory plastic vanes operating in the rocket exhaust. Small cruciform movable fins on nose section provide control after separation.

POWER PLANT.—One North American Rocketdyne A-6 liquid-propellent (liquid oxygen and alcohol) sustainer, giving 75,000 lb. (34,000 kg.) s.t. No booster.

GUIDANCE.—Ford Instrument Co. inertial system. Flight path is taped into missile before launching and play-back signals activate guidance system in flight, keeping missile on pre-computed path.

WARHEAD.—Choice of high-explosive or nuclear type.

DIMENSIONS.—
Length 63 ft. (19.20 m.).
Body diameter 5 ft. 10 in. (1.77 m.).
Span of fins 12 ft. (3.66 m.).

WEIGHT.—
Firing weight 45,000 lb. (20,400 kg.).

PERFORMANCE.—
Speed at burn-out Mach 5.
Range 180-250 miles (290-400 km.).

THE JUPITER-A and JUPITER-C.

Despite their names, these missiles are basically Redstone airframes, and are related to the operational Jupiter IRBM only by being products of the same design team and manufacturer, and because they are used mainly as test vehicles for Jupiter components.

Jupiter-A was a specially-instrumented Redstone, of which later models incorporated components of the Jupiter. Firing tests began at Patrick Air Force Base, Florida, in 1956, simultaneously with tests of a further research vehicle named Jupiter-C. This also is basically a Redstone, but with two further rocket stages built on to its nose for re-entry trials of Jupiter nose-cones.

In the standard Jupiter-C, a single Recruit solid-propellent rocket carrying the nose-cone stands on a cluster of four Recruits mounted on the nose of a Redstone airframe. A rocket of this type set up speed, distance and altitude records in 1957 with a flight of 3,300 miles (5,300 km) from Patrick A.F.B.

An adaptation of Jupiter-C was used to place America's first Earth satellite into orbit, as described on page 425.

THE JUPITER.
U.S.A.F. designation: SM-78.

Jupiter, like Redstone, was designed by the U.S. Army Ballistic Missile Agency,



The SM-78 Jupiter.

under the supervision of Dr. Wernher von Braun, and is produced by Chrysler. It is an intermediate range ballistic missile (IRBM), and was at one time in danger of beng abandoned, because of a 1955 decision to limit U.S. Army responsibility to weapons with a range of under 200 miles (320 km.). As a compromise, it was subsequently developed by the Army for operation by the U.S.A.F.

After two unsuccessful firings, the third test round achieved the designed range of 1,500 miles (2,400 km.) in May 1957. Three months later, another test round climbed to a height of 400 miles (645 km.), after which its small-scale nose-cone survived a re-entry speed of 12,000 m.p.h. (19,300 km.h.) and landed within a previously-determined 1,200 ft. (365 m.) circle. It was recovered from the Atlantic and was demonstrated publicly by President Eisenhower as proof that America had solved the re-entry problem. A full-size nose-cone was recovered after a successful firing on May 18, 1958.

In 1958, Jupiter was in initial production and was scheduled to be deployed operationally in Europe by the end of the year.

TYPE.—Surface-to-surface guided weapon.
WINGS.—None.
BODY.—Cylindrical all-metal structure of constant diameter.
TAIL SURFACES.—None.
POWER PLANT.—One North American Rocketdyne S-3 liquid-propellent (liquid oxygen and kerosene) sustainer, giving 160,000 lb. (72,570 kg.) s.t. Motor is gimbal-mounted as the missile's sole means of providing directional control and stability. No booster.
GUIDANCE.—Ford Instrument Co. inertial system.
WARHEAD.—Goodyear Aircraft nose-cone containing nuclear warhead.
DIMENSIONS.—
Length 58 ft. (17.68 m.).
Body diameter 8 ft. 9 in. (2.67 m.).
WEIGHT.—
Firing weight 105,000 lb. (47,625 kg.).
PERFORMANCE (approx.).—
Speed at burn-out Mach 15.
Range over 1,500 miles (2,400 km.).

CONVAIR

CONVAIR DIVISION OF GENERAL DYNAMICS CORPORATION.

HEAD OFFICE: SAN DIEGO 12, CAL.
Officers: See "Aircraft" Section.
ASTRONAUTICS DIVISION: 5001 KEARNEY VILLA ROAD, SAN DIEGO 12, CAL.
Manager: J. R. Dempsey.
Manager of Operations: W. L. Young.
Director of Scientific Research: C. L. Critchfield.

Much of Convair's early guided weapon activity was directed towards perfecting the Terrier surface-to-air missile for the U.S. Navy. This is now standard equipment on several cruisers and is in quantity production in the company's plant at Pomona, California, side-by-side with the newer and smaller Tartar.

Of even greater significance is the great programme of research and development, under Convair direction, that has produced the Atlas, first intercontinental ballistic missile (ICBM) to reach production status outside Russia. To handle this immense project, Convair formed a special Astronautics Division, with its own large plant, and built extensive static testing and component testing facilities at Sycamore Canyon and Point Loma, near San Diego.

THE ATLAS.

U.S.A.F. designation: SM-65A (WS-107A-1).

Once referred to as the greatest single engineering project ever undertaken, the development of this ICBM was almost abandoned at one stage when it was calculated that a weapon of the required performance would weigh 200 tons and need seven rocket engines, each of 125,000 lb. (56,700 kg.) s.t. for the first stage alone. Then U.S. scientists produced a lightweight thermonuclear warhead, and a missile of the present, reduced size became practicable.

Development has not been easy and the first flight tests in June and September 1957 ended in destruction of the missiles. The first successful firing, using only the power of the two booster motors, took place on December 17, 1957, followed by the first firing with sustainer and booster working simultaneously on August 2, 1958.

Simultaneous firing of all three engines is made possible by the unique side-by-side power plant arrangement. When the boosters jettison after burn-out, they take with them the large flared "skirt" around the tail of the missile, which helps to provide stability during the initial stages of flight. The nose-cone, with the warhead, separates in the final phase, entering the atmosphere alone.

Another feature of the Atlas is that its external skin is so thin that it has to be pressurised during ground transport and as the propellents are burned in flight, to preserve its shape. The result is a considerable reduction in structure/weight ratio.

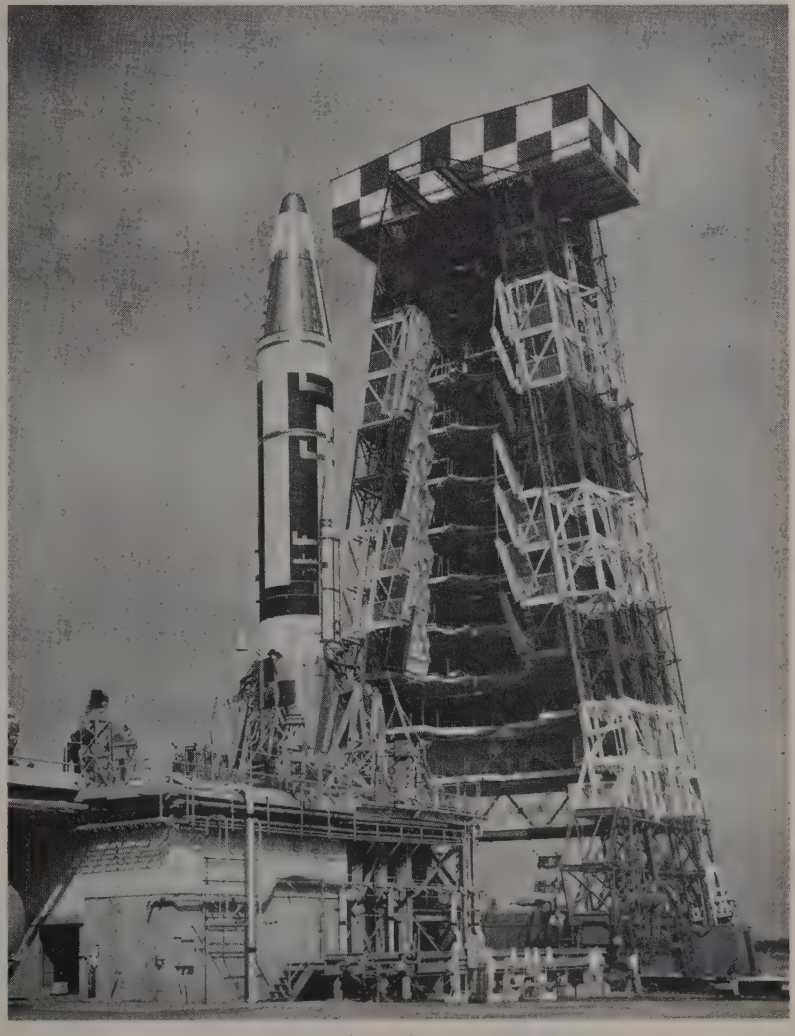
It is hoped to have 40 operational Atlas missiles ready for action from U.S.A.F. Strategic Air Command launching sites in 1959.

TYPE.—Surface-to-surface guided weapon.
WINGS.—None.
BODY.—All-metal structure, largely of steel, forming integral tankage for propellents. Side fairings contain guidance equipment and booster motors.
TAIL SURFACES.—None.
POWER PLANT.—One North American Rocketdyne liquid-propellent sustainer (60,000 lb. = 27,200 kg. s.t.) in tail of body, flanked on each side by a North American Rocketdyne liquid propellent booster (165,000 lb. = 74,860 kg. s.t. each). All three motors fire together for take-off. Liquid oxygen and kerosene propellents in integral tanks.
GUIDANCE.—Initial production models have radar-Doppler command guidance, operating in conjunction with General Electric ground radar and a Burroughs computer. Later models will utilise the Bosch-Arma inertial system being developed for the Titan ICBM.
WARHEAD.—Nuclear or thermonuclear type in General Electric nose-cone.
DIMENSIONS (approx.).—
Length 75 ft. (22.9 m.).
Body diameter 10 ft. (3.05 m.).
WEIGHT.—
Firing weight 243,000 lb. (110,220 kg.).
PERFORMANCE (estimated).—
Speed at burn-out Mach 15-20.
Range 5,500-6,200 miles (8,850-10,000 km.).

THE TARTAR.

Described as a junior version of the Terrier, with a comparable range, the Tartar was ordered into pilot production at Convair-Pomona, by the U.S. Navy, in March 1958. The pilot production missiles will be used for testing and evaluation at the Naval Ordnance Test Station at China Lake, Cal., and on board the U.S.S. *Norton Sound*, prior to the start of full production.

Tartar is designed for use from ships as small as destroyers and for secondary batteries on board cruisers. Present plans



The Convair Atlas and its servicing gantry.

are to install production missiles of this type in 13 guided missile destroyers, now being built, and in the heavy cruisers *Chicago*, *Albany* and *Fall River*.

Like the Terrier, Tartar is a solid-propellent weapon, developed jointly by Convair and the Applied Physics Laboratory of Johns Hopkins University. It is a beam rider, with power plant by Aerojet-General and Allegany Ballistics and Convair guidance.



Convair Terrier missiles on the U.S.S. *Canberra*.

THE TERRIER.

U.S. Navy designation: SAM-N-7.

First operational surface-to-air missile of the U.S. Navy, Terrier is an offshoot of the Bumblebee ramjet programme begun in 1945 by the Applied Physics Laboratory of Johns Hopkins University. It was first fired from a ship, the U.S.S. *Norton Sound*, in September 1951, and has been in production at Convair-Pomona since 1952.

Ships armed with Terriers are the guided missile cruisers *Boston* and *Canberra*, and the destroyer *Gyatt*. Two aircraft carriers, three conventional cruisers, the nuclear cruiser *Long Beach* and nine ships of the frigate class are also to be equipped with these weapons. In addition, an anti-aircraft battalion of the U.S. Marine Corps is using Terriers launched from mobile trailers.

Loading and firing from the standard shipboard twin-launcher is automatic.

TYPE.—Surface-to-air guided weapon.

WINGS.—Pivoted cruciform wings of tapered planform mounted at mid-point of body.

BODY.—Cylindrical all-metal structure.

TAIL SURFACES.—Fixed cruciform fins mounted at rear of body and indexed at 45° to wings.

POWER PLANT.—One Allegany Ballistics solid-propellent sustainer. One Allegany Ballistics solid-propellent jettisonable booster in tandem, with four large stabilising fins indexed at 45° to wings.

GUIDANCE.—Beam-riding type of Sperry design.

DIMENSIONS.—
Length with booster 27 ft. (8.23 m.).
Length without booster 15 ft. (4.57 m.).
Span of wings approx. 3 ft. 6 in. (1.07 m.)

WEIGHT (approx.).—
Firing weight 3,300 lb. (1,500 kg.).

PERFORMANCE (approx.).—
Speed at burn-out Mach 2.5.
Range 10 miles (16 km.).

DOUGLAS

DOUGLAS AIRCRAFT COMPANY, INC.

HEAD OFFICE AND WORKS: SANTA MONICA, CALIFORNIA.

Officers: See "Aircraft" Section.

Director of Missiles and Space Systems Engineering: E. P. Wheaton.

Chief Engineer, Missiles and Space Systems: R. L. Johnson.

By the spring of 1958, Douglas had produced 19,000 missiles of all types since entering the guided weapons field in 1941. In some instances, such as the Nike series of surface-to-air weapons, they are manufacturers of designs for which other companies are prime contractors. Current products of their own design include the Genie air-to-air nuclear missile and the Thor IRBM.

THE GENIE.

U.S.A.F. designation: MB-1.

Genie is an unguided air-to-air rocket missile with a nuclear warhead of about 1.5 kilotons yield, giving it a near-miss range of 2,500 ft. (750 m.) or more by blast alone. Its development was started by Douglas in 1955, as soon as a suitable atomic warhead package had been perfected and the first-ever air-to-air firing of a nuclear missile took place on July 19, 1956, when a Genie was released from an F-89J Scorpion interceptor over Yucca Flat, Nevada.

In this case the weapon was fired at a height of about 15,000 ft. (4,575 m.), after which the pilot of the F-89J turned sharply to escape the blast. The missile travelled 3 miles (4.8 km.) horizontally and was detonated by a signal from the ground. The negligible extent of the fall-out was demonstrated by U.S.A.F. observers who stood directly under the detonation point for an hour, with no ill effects.

Whilst under development, the MB-1 was known successively as Ding-Dong, Bird Dog and High Card, before entering service as the Genie. A training version, without nuclear warhead, is reported to be in production as the Ting-a-Ling.

Genie is carried externally on heavy Douglas-designed pylons on the F-89J, F-101 and F-102, and internally on the F-106. It is normally fired automatically and detonated by a Hughes fire-control system carried by the launching aircraft. Only guidance on the initial version is provided by a gravity-correction device which actuates the movable fin-tips, but later models with a proper built-in guidance system are under development.

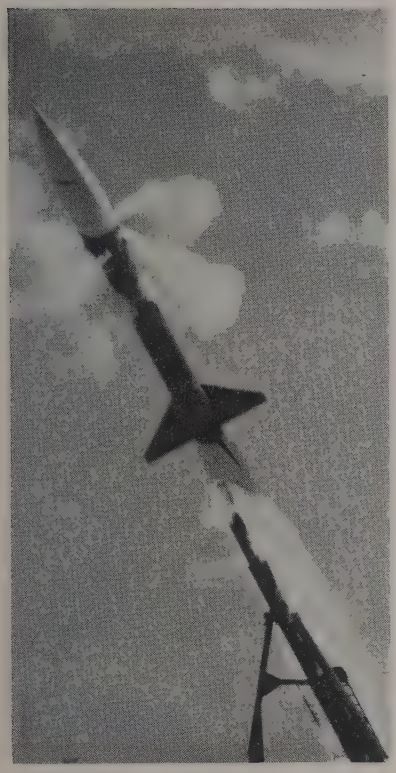
The sustainer is an Aerojet-General solid-propellent rocket, and no booster is used. As one of many safety precautions, Genie remains inert in the nuclear sense until it is armed in the air, a few moments before firing.

DIMENSIONS (approx.).—
Length 8 ft. (2.44 m.).
Body diameter 1 ft. 3 in. (0.38 m.).
Span of fins 2 ft. (0.61 m.).

WEIGHT AND PERFORMANCE.—
No details available.



The Douglas MB-1 Genie nuclear air-to-air missile.



The Honest John unguided rocket.

THE HONEST JOHN.

U.S. Army designation: M-31.

Honest John is a simple spin-stabilised close support artillery rocket, which can carry either a nuclear or high explosive warhead and can be fired by less than six men if necessary. It is fired from a self-propelled launcher.

Development was started by Douglas in mid-1950, under the technical supervision of the Army Ballistic Missile Agency at Redstone Arsenal. Initial tests at White Sands Proving Ground in the following year led to the first production orders and Honest John has since been built in very large numbers by both Douglas and Emerson Electric. It is in service with the U.S. Army in Europe and Japan and is being supplied to other NATO forces.

TYPE.—Surface-to-surface unguided missile.
WINGS.—None.
BODY.—Cylindrical sheet steel structure.
TAIL SURFACES.—Cruciform fixed tail-fins, canted to maintain spin of rocket throughout flight.
POWER PLANT.—One Hercules Powder Company solid-propellent rocket motor. No booster.
GUIDANCE.—None. Initial spin-stabilisation provided by four small tangential rockets aft of warhead.
WARHEAD.—Choice of nuclear or high-explosive. Weight 1,500 lb. (680 kg.). General Electric arming and fusing.
DIMENSIONS.—
Length 27 ft. 3 in. (8.31 m.).
Body diameter 2 ft. 6 in. (0.76 m.).
Span of fins 9 ft. 1 in. (2.77 m.).
WEIGHT.—
Firing weight 5,820 lb. (2,640 kg.).
PERFORMANCE.—
Speed Mach 1.5.
Range 20 miles (32 km.).

THE LITTLE JOHN.

U.S. Army designation: XM-47.

Much smaller and lighter in weight than Honest John, this spin-stabilised artillery rocket can be transported by helicopter or light aircraft and is intended to provide highly-accurate all-weather close support for even airborne units. Together with Lacrosse, it is expected to replace Honest John eventually.

Development began at Redstone Arsenal in February 1956 and the first round was fired four months later. Production is by Emerson Electric and Douglas.

TYPE.—Surface-to-surface missile.
WINGS.—None.
BODY.—Cylindrical all-metal structure.
TAIL SURFACES.—Cruciform tail-fins, apparently movable.
POWER PLANT.—One Allegany Ballistics Laboratory solid-propellent sustainer. No booster.
GUIDANCE.—No details available. May be unguided.
WARHEAD.—High-explosive type, from Picatinny Arsenal. General Electric arming and fusing.
DIMENSIONS.—
Length 12 ft. (3.66 m.).
Body diameter 1 ft. (0.30 m.).
Span of fins 2 ft. 6 in. (0.76 m.).
WEIGHT.
Firing weight 980 lb. (445 kg.).
PERFORMANCE.—
Range 10 miles (16 km.).

THE THOR.

U.S.A.F. designation: SM-31.

When the U.S. Government assigned to the U.S.A.F. responsibility for all guided weapons with a range of more than 200 miles (320 km.) in November 1955, Douglas were made prime contractors of a U.S.A.F. "crash programme" to develop an intermediate-range ballistic missile to compete with the Army's Jupiter.

By utilising design experience gained with the Atlas and Titan ICBM projects, Douglas were able to have the first experimental round ready for firing within only twelve months. The first five launchings were unsuccessful, but the sixth, on September 20, 1957, produced a flight of 1,350 miles (2,170 km.), with successful telemetering of data. The seventh test missile exceeded its designed performance, by flying about 2,000 miles (3,200 km.), and the weapon was eventually ordered into production as the SM-75 Thor.

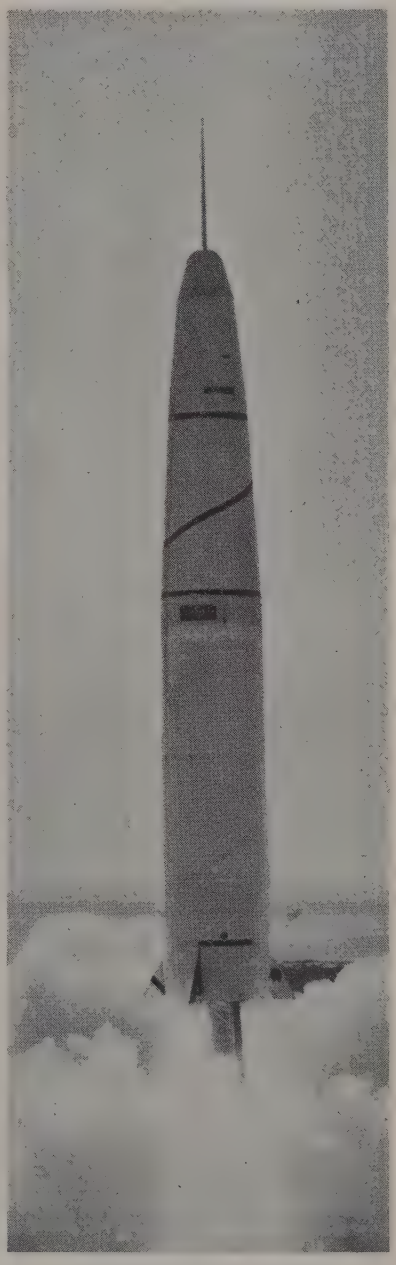
One of the requirements of the specification was that Thor and its support equipment should be air-transportable in aircraft like the C-124 and C-133, and the first missiles of this type deployed for operational use in England in September 1958 were brought across the Atlantic by air. They will be operated by both the U.S.A.F. and R.A.F. Transport Command.

Thor missiles also form the basis of the U.S.A.F.'s Thor-Able re-entry test vehicle programme, lunar probe project and a reconnaissance satellite programme.

TYPE.—Surface-to-surface guided weapon.
WINGS.—None.
BODY.—Circular-section aluminium structure, providing integral tankage for propellents. Lightweight integrally-stiffened design.
TAIL SURFACES.—Four small fixed tail-fins to assist stability in initial stages of flight.
POWER PLANT.—One North American Rocketdyne S-3 liquid-propellent (liquid oxygen and kerosene) sustainer, giving 160,000 lb. (72,570 kg.) s.t. Motor is gimbal-mounted to provide directional control and stability. No booster.
GUIDANCE.—A.C. Spark Plug inertial guidance system.
WARHEAD.—General Electric nose-cone and nuclear warhead.
DIMENSIONS.—
Length 62 ft. (18.90 m.).
Body diameter 9 ft. (2.74 m.).
WEIGHT.—
Firing weight approx. 100,000 lb. (45,360 kg.).
PERFORMANCE.—
Speed at burn-out Mach 10-15.
Nominal range 1,500 miles (2,400 km.).



The Little John unguided rocket.



The Douglas Thor IRBM.

EMERSON ELECTRIC

THE EMERSON ELECTRIC MANUFACTURING COMPANY, ELECTRONICS AND AVIONICS DIVISIONS.

HEAD OFFICE: 8100 FLORISSANT AVENUE, ST. LOUIS 21, MISSOURI.

This company shares with Douglas responsibility for production of the U.S. Army's Honest John and Little John artillery missiles, both of which are described under the "Douglas" entry above.

FAIRCHILD

FAIRCHILD ENGINE AND AIRPLANE CORPORATION, GUIDED MISSILES DIVISION.

DIVISIONAL OFFICE AND WORKS: WYANDANCH, LONG ISLAND, N.Y.

Officers: See "Aircraft" section.

Fairchild's first operational guided weapon, now approaching obsolescence, was the very efficient Petrel air-to-underwater anti-shipping missile.

Currently, the company is developing a series of unique bomber defence weapons of which the long-range air-breathing Bull Goose decoy missile was undergoing flight test evaluation at Cape Canaveral, Florida, in the spring of 1958. It was reported to be more trouble-free at that time than almost any other development missile.

THE BULL GOOSE.

U.S.A.F. designation: SM-73.

Known also as Goose and Blue Goose, this unique long-range air-breathing missile is intended to fly in advance of Strategic Air Command bombers to confuse enemy radar and attract the attention of enemy missile and fighter defences, so protecting indirectly, the crews of the piloted bombers. It is built largely of resin-bonded dielectric materials.

Bull Goose is launched from a zero-length ramp and can be equipped with a variety of devices to activate every known kind of defensive equipment and missile homing systems. It might also be arranged to home itself on to the source of enemy radar signals, carrying a light warhead. It will be operated by the U.S.A.F. Strategic Air Command.

TYPE. Surface-to-air decoy weapon.

WINGS.—Cantilever mid-wing monoplane of delta planform, with elevons inset in trailing-edges.

BODY.—Area-ruled structure, with ventral air intake for turbojet.

TAIL SURFACES.—Vertical fin only.

POWER PLANT.—One Fairchild J83 turbojet sustainer, giving approximately 2,200 lb. (1,000 kg.) s.t. Thiokol solid-propellent jettisonable booster, giving approximately 100,000 lb. (45,360 kg.) s.t., attached under rear of body.

GUIDANCE.—Fairchild system. Possibly inertial.

DIMENSIONS, WEIGHT AND PERFORMANCE. No details available.



The Firestone Corporal.

THE DUCK.

The Duck is reported to be an air-to-air bomber defence missile (BDM) of the same design family as the Bull Goose, for the defence of supersonic bombers like the B-58 Hustler. No details are available.

THE PETREL.

Although no longer in production, Petrel remains in service with maritime reconnaissance squadrons of the U.S. Navy as a reliable and efficient air-to-underwater anti-shipping weapon.

It was developed by Fairchild and the National Bureau of Standards during 1949-51, from the earlier Kingfisher and Grebe projects, and consists basically of a standard Mk. 13 torpedo fitted with an airframe, power plant and underwater radar homing system for improved range and accuracy.



The Fairchild Petrel.

Petrel is air-launched from beneath the wing of aircraft such as the Neptune patrol-bomber and Marlin flying-boat, to attack targets at sea without any need for the launching aircraft to approach the target's close defences. Guided by radio command, it sheds its wings, twin-finned tail unit and Fairchild J44 turbojet (1,000 lb.= 450 kg. s.t.) at a certain pre-determined range, enters the water and completes its run as a normal homing torpedo.

DIMENSIONS.—
Length 24 ft. (7.32 m.).
Span of wings 13 ft. (3.96 m.).
Span of tail unit 8 ft. (2.44 m.).

WEIGHT.—
Launching weight 3,800 lb. (1,725 kg.).

PERFORMANCE.—
Cruising speed Mach 0.7.
Range 5 miles (8 km.).

FIRESTONE

THE FIRESTONE TIRE AND RUBBER COMPANY, GUIDED MISSILE DIVISION.

HEAD OFFICE: 2525 FIRESTONE BOULEVARD, LOS ANGELES 54, CALIFORNIA.

Firestone have the distinction of being the manufacturers of the first ballistic missile to enter service in the United States. Known as the Corporal, this weapon is a comparatively short-range tactical bombardment rocket, of which the basic design was produced by the Jet Propulsion Laboratory of the California Institute of Technology. It has been in service for some years with the U.S. Army and is used also by the British Army.

THE CORPORAL.

U.S. Army designation: SSM-A-17.

Corporal is the liquid-propellent surface-to-surface bombardment weapon with which both the U.S. and British Armies have gained experience in missile handling techniques. It is fired from a simple light-metal pedestal, on to which it is placed by a self-propelled electrically-actuated erector.

Guidance data is pre-computed and entered as dial settings before launching. Small corrections to the trajectory can be made by command guidance during flight.

TYPE.—Surface-to-surface guided weapon.

WINGS.—None.

BODY.—Cylindrical steel structure.

TAIL SURFACES.—Cruciform tail-fins with movable rudders and vanes operating in the rocket exhaust.

POWER PLANT.—Liquid-propellent (nitric acid and aniline) sustainer manufactured by Ryan. No booster.

GUIDANCE.—Command type guidance, manufactured by Gilfillan.

WARHEAD.—Choice of nuclear or high-explosive type. General Electric arming and fusing.

DIMENSIONS.—
Length 46 ft. (14.02 m.).
Body diameter 2 ft. 6 in. (0.76 m.).
Span of fins 7 ft. (2.13 m.).

WEIGHT.—
Firing weight 12,000 lb. (5,445 kg.).

PERFORMANCE.—
Speed at burn-out Mach 3.
Range 75-100 miles (120-160 km.).

GOODYEAR

GOODYEAR AIRCRAFT CORPORATION.

HEAD OFFICE: 1210 MASSILLON ROAD, AKRON 15, OHIO.

Officers: See "Aircraft" section.

Goodyear are engaged on a wide variety of important sub-contract design, development and manufacturing work for the U.S. guided weapon industry, examples of their products being the nose-cone for the Jupiter IRBM, guidance system for the TM-76A Mace surface-to-surface "flying bomb" and ground support equipment for the Atlas ICBM.

In addition, the company is prime contractor for a new U.S. Navy missile known as Subroc, of which brief details are given hereafter.

THE SUBROC.

Based on a wartime German concept, Subroc (submarine rocket) will be initially an underwater-to-air-to-underwater long-range missile for anti-submarine warfare. Later developments may include strategic bombardment and surface-to-air weapons.

Major feature of Subroc is that it will be launched from the conventional torpedo tubes of the submarine carrying it, dispensing with the need for special deck equipment and stowage. Fired underwater, it will be propelled to the surface and will cover most of its course to the target through the air.

Sub-contractors include the Librascope and Kearfott companies.

Subroc will have a length of 14 ft. (4.27 m.).

HUGHES

HUGHES AIRCRAFT COMPANY.

HEAD OFFICE: CULVER CITY, CALIFORNIA.

MISSILE MANUFACTURING DIVISION: P.O. Box 5555, TUCSON, ARIZONA.

Hughes Aircraft began developing an air-to-air weapon for the U.S.A.F. in 1950, and this weapon has now been in squadron use for some years as the GAR-1 Falcon. Advanced versions currently in production are the radar-homing GAR-1D and the infra-red GAR-2.

Hughes also manufacture the fire-control systems used by every U.S.A.F. and R.C.A.F. interceptor.

THE FALCON.

U.S.A.F. designations: GAR-1 and GAR-2.

First air-to-air guided weapon adopted by the U.S.A.F., Falcon is standard armament in wing-tip pods on the F-89 Scorpion, in the internal weapons bay of the F-102 Delta Dagger and F-106 Delta Dart, semi-internally under the fuselage of the F-101B Voodoo, and on other interceptors.

It is a remarkably compact weapon, which has been produced in three versions:

GAR-1.—Initial production version with semi-active radar homing. Control surfaces hinged directly to trailing-edges of wings.

GAR-1D.—Similar to GAR-1, but with improvements giving better performance and manoeuvrability at height. Gap between control surfaces and wings.

GAR-2A.—Airframe similar to GAR-1D, but with passive homing (infra-red) head behind transparent nose dome. Firing trials have shown the GAR-2A to offer a slightly higher kill probability than the radar-homing versions, especially under all-weather conditions. A mixed armament of both versions will probably be normal, giving a kill probability of up to 90%.

TYPE.—Air-to-air guided weapon.

WINGS.—Fixed cruciform wings of large-chord planform, made up of Fiberglas skin over magnesium frame. Control surfaces attached to trailing-edges.

BODY.—Cylindrical structure of magnesium castings manufactured largely by Solar Aircraft.

TAIL SURFACES.—Tail-first design. Four small stabilising fins on nose.

POWER PLANT.—One Thiokol M58-E4 solid-propellent sustainer (6,000 lb. = 2,720 kg. s.t.). No booster.

GUIDANCE (GAR-1 and 1D).—Hughes semi-active homing, in which radar signals transmitted by the launching interceptor and reflected from the target are picked up by a receiver in the nose of the missile, which uses them to home on to the source of the reflections.

GUIDANCE (GAR-2A).—Passive (infra-red) homing.

WARHEAD.—High-explosive type.

DIMENSIONS.—
Length 6 ft. 6 in. (1.98 m.).
Body diameter 6¼ in. (0.17 m.).
Span of wings 1 ft. 8 in. (0.51 m.).

WEIGHT.—
Firing weight (GAR-1D) 110 lb. (50 kg.).
Firing weight (GAR-2A) 122 lb. (55 kg.).

PERFORMANCE (estimated).—
Cruising speed above Mach 2.
Range 5 miles (8 km.).



The GAR-2A Falcon (left) and GAR-1D Falcon (right).

LOCKHEED

LOCKHEED AIRCRAFT CORPORATION.

HEAD OFFICE AND WORKS: BURBANK, CALIFORNIA.

Officers: See "Aircraft" Section.

MISSILE SYSTEMS DIVISION: SUNNYVALE, CALIFORNIA.

Department Manager: J. B. McChesney.

Lockheed's major missile commitments at the present time are the highly-promising Polaris fleet ballistic missile, which will be launched from submerged submarines, and a reconnaissance satellite covered by the weapon system designation of WS-117L.

This company is also producing the X-7 ramjet test vehicle and the X-17 re-entry test vehicle for the U.S.A.F. The Q-5 Kingfisher recoverable ramjet target missile is described in the "Aircraft" section of this work.

THE WS-117L SENTRY.

Weapon System 117L is the designation of a reconnaissance satellite with a large recoverable capsule, which is under development by Lockheed. Little reliable information about it is available, but the original code-names of, successively, Big Brother, Pied Piper and Sentry have been followed by the code-name SNAP. This stands for Secondary Nuclear Auxiliary Power and strengthens reports that the ultimate versions will use a form of nuclear power to operate the reconnaissance equipment for long periods.

Initially, it is expected that development will be centred on the use of Thor-Able test vehicles. Later, an Atlas booster and a solid-propellent second stage will be used to put a payload of more than one ton into orbit. This payload will consist mainly of batteries, but Martin are investigating the use of radioactive isotopes as a heat source for an auxiliary power plant, and Atomics International are working on a thermal nuclear reactor for installation in the developed WS-117L.

THE LOCKHEED X-7.

Resembling a small straightwing interceptor, the X-7 is a supersonic pilotless test vehicle for ramjet engines and missile components, with the ramjet under test mounted externally under the rear fuselage.

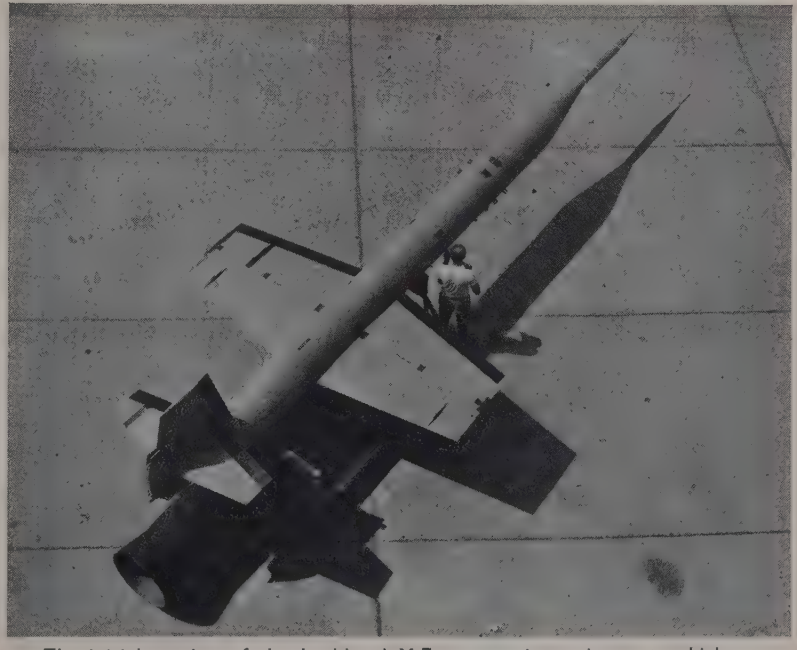
The original version, launched from beneath the wing of a B-29 Superfortress, broke all speed and altitude records for air-breathing missiles whilst testing the type of Marquardt ramjets fitted in the IM-99A Bomarc interceptor missile. A new and more streamlined version, first delivered to the U.S.A.F. in the Summer of 1958, is launched from the bomb-bay of a B-50 Superfortress and is capable of flight testing the more powerful ramjets now under development by Marquardt for use in later weapons, including the IM-99B.

Features of the new-type X-7, which is 37 ft. (11.28 m.) long, include the ability to carry any of four different types of Marquardt ramjet; the use of a recently-perfected autopilot which responds to commands in $\frac{1}{16}$ sec.; installation of advanced camera instrumentation to permit twice as much film coverage during each flight; the substitution of a pair of underwing rocket boosters for the single rear-mounted rocket previously used, permitting either ground or air launching; and reinforced structure to permit higher performance in all respects.

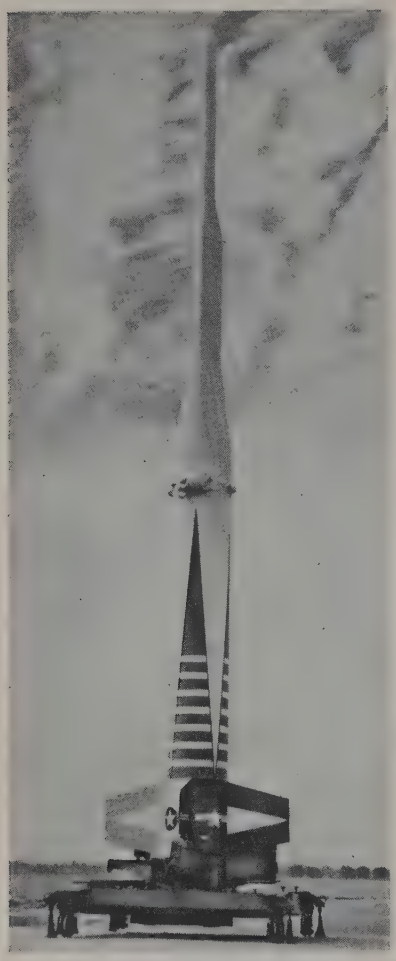
Both versions of the X-7 are flown under command guidance from the ground and are fully-equipped to telemeter back research data during flight. A parachute and nose spike recovery system enables them to be used many times, thereby saving about £125,000 per flight compared with the use of a non-recoverable missile.

THE LOCKHEED X-17.

This large three-stage solid-propellent rocket is a test vehicle for ICBM and IRBM components, and has been used widely in the development of re-entry warheads for weapons such as Lockheed's



The initial version of the Lockheed X-7 supersonic ramjet test vehicle.



The Lockheed X-17 three-stage re-entry test vehicle.

own Polaris. It is 40 ft. (12.20 m.) long, with a launching weight of 12,000 lb. (5,445 kg.), and is so designed that, after the first two stages have burned out, the third stage carrying the warhead turns over and accelerates the nose-cone downward towards the ground.

THE POLARIS.

Although it is comparable in range to a land-based IRBM, and has the effective range of an ICBM by virtue of the fact that it can be launched from a highly-mobile submarine, Polaris is a relatively small, squat missile. Its high performance has been made possible by use of solid-propellent rocket motors of great efficiency and acceptance of a smaller nuclear warhead than that fitted in its land-based counterparts. Known officially as a Fleet Ballistic Missile System (FBMS), Polaris was first stated by the U.S. Navy to be under development early in 1957, with the first representative missile scheduled to be fired in 1959. Meanwhile, the nose-cone and warhead are being developed by the use of Lockheed X-17 re-entry test vehicles, and underwater firing tests are being conducted with dummy missiles.

No details of the launching technique have been given officially, but it is believed that the missiles are fired torpedo-fashion from individual containers on the submarine by compressed air, and then complete a ballistic trajectory through the air by means of their conventional propulsion and guidance systems.

A new class of nuclear-powered submarines now under construction will each carry 16 Polaris missiles, which are equally suitable for launching from other ships or shore bases.

TYPE.—Underwater-to-surface or surface-to-surface guided missile.

WINGS.—None.

BODY.—Two-stage, cylindrical metal structures.

TAIL SURFACES.—None.

POWER PLANT.—Two-stage design. First stage is an Aerojet-General solid-propellent motor with four nozzles, developing a total of 80,000-100,000 lb. (36,300-45,300 kg.) s.t. Second stage is either an Aerojet-General or Thiokol solid-propellent motor with three nozzles and jet-deflection control vanes.

GUIDANCE.—Inertial system, developed under overall responsibility of Massachusetts Institute of Technology and manufactured by General Electric.

WARHEAD.—Nuclear type.

DIMENSIONS.—
Length 26 ft. 6 in. (8.07 m.).
Body diameter 4 ft. 6 in. (1.37 m.).

WEIGHT.—
Firing weight approx. 28,000 lb. (12,700 kg.).

PERFORMANCE (estimated).—
Speed at burn-out Mach 10.
Range 1,500 miles (2,400 km.).



Right : the Lockheed Polaris Fleet Ballistic Missile.

McDONNELL

McDONNELL AIRCRAFT CORPORATION.

HEAD OFFICE AND WORKS: ST. LOUIS 3, MISSOURI.

Officers: See "Aircraft" Section.

McDonnell have been major sub-contractors for the Talos surface-to-air missile programme for several years, manufacturing both the ramjet engines and much of the airframe for this weapon. In addition, they are developing a diversionary missile of their own, known as Green Quail, and brief details of this are given hereafter.

THE GREEN QUAIL.

U.S.A.F. designation: GAM-72.

Scheduled to fly during 1958, Green Quail is an air-launched bomber defence missile, carrying countermeasures equipment to protect the launching aircraft from all types of radar, infra-red and other interception techniques.

Few details are available except that it will have a guidance system by the Summers Gyroscope company and will be non-recoverable, presumably having a self-destruction device.

MARTIN

THE MARTIN COMPANY.

HEAD OFFICE AND WORKS: BALTIMORE 3, MARYLAND.

Officers: See "Aircraft" section.

DENVER DIVISION: DENVER 1, COLORADO.

Vice-President and General Manager: H. W. Merrill.

Director of Manufacturing: R. M. Blakey.

Director of Engineering Research: A. C. Hall.

Martin have built a completely new works at Denver, Colorado, to handle development and production of the Titan intercontinental ballistic missile (ICBM), for which they are prime contractors.

They are also manufacturing a variety of other guided weapons, of which details are given below, and head one of the two teams which are producing competitive design studies for the U.S.A.F.'s. Dyna-Soar rocket-boosted glider project.

THE DYNA-SOAR.

Brief details of this important U.S.A.F. project are given under the "Boeing" entry in this section of "All the World's Aircraft". The design study team headed by Martin includes also the Bell, Goodyear, American Machine & Foundry, Bendix and Minneapolis-Honeywell companies.

THE BULLPUP.

U.S. Navy designation: ASM-N-7.

Martin developed Bullpup from design-study to flight-testing in a period of less than two years, after winning a U.S. Navy competition against 13 other companies. They are producing it for the Navy and Marine Corps in their Orlando, Florida, plant.

It is a very simple air-to-surface weapon, built around a variety of 250 lb. (113 kg.) bombs and intended to provide a means of attacking pin-point targets or of giving close support to ground forces without need for the launching aircraft to expose itself to short-range ground-fire around the target.

After manufacture, Bullpup can be placed in storage for up to six months without re-check; its three components can then be assembled and mounted on an aircraft in five minutes by three men. It is controlled in flight by a button in the cockpit which gives pitch and yaw guidance.

A modified version of Bullpup, known as White Lance, will be used by the U.S.A.F. Tactical Air Command.

TYPE.—Air-to-surface guided weapon.
WINGS.—Fixed cruciform wings, with swept leading-edges, mounted near tail of missile.
BODY.—Cylindrical all-metal structure.
TAIL SURFACES.—Tail-first design. Movable cruciform fore-planes of delta planform on nose.
POWER PLANT.—One Allegany Ballistics Laboratory solid-propellent sustainer, manufactured by Aerojet-General. No booster.
GUIDANCE.—Radio command system. Tracking flares above and below rocket nozzle.
WARHEAD.—250 lb. (113 kg.) high-explosive bomb.
DIMENSIONS.—
Length 11 ft. (3.35 m.).
Body diameter 1 ft. (0.30 m.).
Span of wings 3 ft. 1 in. (0.94 m.).
WEIGHT.—
Firing weight 540 lb. (245 kg.).
PERFORMANCE (estimated).—
Cruising speed Mach 1.8.
Range 3 miles (5 km.).

THE LACROSSE.
U.S. Army designation: SSM-A-12.

Lacrosse was designed and developed, under Army Ordnance contract, by the Cornell Aeronautical Laboratory of Buffalo, New York. As Cornell do no production work, Martin co-operated with them in the final development stages and are building the weapon at their Orlando plant. The first production round came off the assembly line in August 1957.

Lacrosse is a versatile close and general support weapon of high accuracy and mobility. It is carried on a zero-length launcher on a standard army truck, which can be positioned in the rear of a combat area, with the operator in an advanced observation post, firing and guiding it by remote control. The target need not be visible, provided its precise position is known, so that Lacrosse can be used in all weathers and at night.

TYPE.—Surface-to-surface guided weapon.
WINGS.—Fixed cruciform wings mounted at approximately mid-point on body. Moderate sweepback. All four wings interchangeable.
BODY.—Cylindrical all-metal structure.
TAIL SURFACES.—Cruciform control surfaces pivoted to tail of body.
POWER PLANT.—One Thiokol solid-propellent sustainer. No booster.
GUIDANCE.—Radar command guidance system by Federal Telecommunications Laboratories.
WARHEAD.—High-explosive type, manufactured by Minneapolis-Honeywell Ordnance Division. General Electric fuse.
DIMENSIONS.—
Length 19 ft. 2½ in. (6.10 m.).
Body diameter 1 ft. 8½ in. (5.20 m.).
Span of wings 9 ft. (2.75 m.).
WEIGHT.—
Firing weight over 3,500 lb. (1,590 kg.).
PERFORMANCE (estimated).—
Range 20 miles (32 km.).

THE MATADOR.
U.S.A.F. designation: TM-61.

First operational guided weapon to be used by the U.S.A.F., the Matador "flying bomb" has been in service for more than four years and equips Tactical Missile Wings in the United States, Germany and Taiwan. The 1,000th Matador was delivered by Martin's Baltimore factory in Mid-1957 and the weapon has been produced in the following versions:

TM-61A.—Initial production version with MSQ radar guidance system using network of ground radar sites for line-of-sight control of missile. No longer in service.

TM-61B.—Re-designated TM-76 Mace and described separately.

TM-61C.—Improved version of TM-61A with Shanicle guidance system. This system transmits a long-range hyperbolic grid from two transmitters, one







Right, top to bottom : the Bullpup air-to-surface missile, the surface-to-surface Lacrosse and the TM-61C "flying bomb."



The Martin Mace on its "Translauncher," towed by a "Teracruzer" tractor.

of which controls the missile in azimuth and the other in range. In production and service. Description below refers to this type.

All versions of the Matador are ramp-launched from a mobile trailer and can carry a nuclear warhead.

TYPE.—Surface-to-surface guided weapon.
WINGS.—Cantilever high-wing monoplane, with sweepback and anhedral. Wings are removable for transport.
BODY.—Cylindrical all-metal structure.
TAIL SURFACES.—Cantilever monoplane type, with tailplane mounted at tip of fin. Movable rudder.
POWER PLANT.—One Allison J33-A-37 turbo-jet sustainer (4,600 lb. = 2,088 kg. s.t.) with under-body air intake. One Aerojet-General jettisonable solid-propellent booster (50,000 lb. = 22,680 kg. s.t. for 2 sec.) attached under tail.
GUIDANCE.—TM-61C has both MSQ and Shanicle systems of radar command guidance. Shanicle offers greater accuracy, ability to control several missiles at once, and better resistance to countermeasures.
WARHEAD.—Choice of nuclear or high-explosive. Weight approximately 3,000 lb. (1,360 kg.).
DIMENSIONS.—
Length 39 ft. 6 in. (12.04 m.).
Body diameter 4 ft. 6 in. (1.37 m.).
Span of wings 28 ft. 7 in. (8.70 m.).
WEIGHT.—
Launching weight 12,000 lb. (5,450 kg.).
PERFORMANCE.—
Cruising speed Mach 0.9.
Range over 500 miles (800 km.).

THE MACE.

U.S.A.F. designation: TM-76.

Originally designated the TM-61B, the TM-76 Mace is an improved development of the Matador which can be recognised by its longer, more rounded nose, containing additional fuel tanks. Its wings are shorter in span and are made to fold, instead of being removable as in the TM-61, and it has a choice of two self-contained guidance systems, as follows:

TM-76A.—Goodyear ATRAN (Doppler) guidance system, which relates a film strip, actual or synthetic, to the terrain over which the missile flies. Any deviation from the programmed route is immediately corrected and the missile can be programmed to vary its altitude, making possible attack at very low altitudes.

TM-76B.—Basically similar to TM-76A, but with A.C. Spark Plug inertial guidance.

The Mace is powered by an Allison J33-A-41 turbojet (5,200 lb. = 2,360 kg. s.t.) and is launched with the aid of an Aerojet-General solid-propellent booster giving considerably more thrust than that of the TM-61.

It is carried on a "Translauncher", which serves as zero-length launcher and transporter, while a "Teracruzer" tractor serves as prime mover for all ground support equipment. Both vehicles are of Goodyear design and travel on huge balloon tyres which can be inflated or deflated automatically by the driver to suit varying terrain.

DIMENSIONS.—
Length 44 ft. (13.40 m.).
Body diameter 4 ft. 6 in. (1.37 m.).
Span of wings 23 ft. (7.01 m.).
WEIGHT (estimated).—
Launching weight 13,800 lb. (6,260 kg.).
PERFORMANCE.—
Speed Mach 0.9.
Range over 650 miles (1,045 km.).

THE PERSHING.

Developed by the Jet Propulsion Laboratory of the California Institute of Technology, Pershing is a surface-to-surface solid-propellent bombardment missile which Martin are building at Orlando for the U.S. Army. It is a two-stage weapon, with power plant by Thiokol and inertial guidance by Bendix. Few details are available, except that it will be able to carry a thermonuclear warhead manufactured by Bulova Watch Co.

THE TITAN.

U.S.A.F. designation: SM-68 (WS-107A-2).

Second of the two intercontinental ballistic missiles (ICBM's) under development for the U.S.A.F., Titan is a liquid-propellent rocket of conventional tandem two-stage layout. It is being produced in Martin's new Denver plant and was due to begin firing trials before the end of 1958.

At take-off, only the 10 ft. (3.05 m.) diameter first-stage rocket is fired. It is jettisoned at burn-out, automatically lighting the smaller second-stage rocket, which contains the guidance and warhead.

Titan makes use of many detail components used also in the Atlas and other weapon systems, but its airframe is entirely new. Two guidance systems are under development for it, consisting of an inertial system by the Bosch-Arma Corporation and a radio-inertial system by the Bell Telephone Laboratories. Its thermo-nuclear warhead is contained in an Avco nose-cone.

TYPE.—Surface-to-surface guided weapon.
WINGS.—None.
BODY.—Cylindrical two-stage structure of light alloy.
TAIL SURFACES.—None. Control by gimbal-mounted rocket motor.
POWER PLANT.—Two-stage layout. First stage is Aerojet-General liquid-propellent rocket giving 300,000 lb. (136,000 kg.) s.t. Second stage is Aerojet-General liquid-propellent rocket giving 60,000 lb. (27,200 kg.) s.t. Both motors use liquid oxygen and kerosene (JP-6) propellents.
GUIDANCE.—Bosch-Arma inertial system. First few only will have Bell Telephone Laboratories radio-inertial system.
WARHEAD.—Thermonuclear type.
DIMENSIONS (approx.).—
Length 92 ft. (28.0 m.).
Body diameter 10 ft. (3.05 m.).
WEIGHT (estimated).—
Firing weight 222,000 lb. (100,700 kg.).
PERFORMANCE (estimated).—
Speed at burn-out Mach 15-20.
Range 5,500 miles (8,850 km.).

MINNEAPOLIS-HONEYWELL

MINNEAPOLIS-HONEYWELL REGULATOR COMPANY, AERONAUTICAL DIVISION.

HEAD OFFICE: 2,600 RIDGWAY ROAD, MINNEAPOLIS 13, MINN.

President: Paul B. Wishart.

Minneapolis-Honeywell's many operating divisions are engaged on producing a wide range of components and support equipment for the U.S. guided weapon programme. These include guidance equipment, warheads, fuzing and ground handling equipment for the Atlas, Polaris, Thor and Titan missiles.

In addition, the company is prime contractor for a new U.S. Navy missile named the Asroc, of which brief details are given hereafter.

THE ASROC.

Little is known at present about this missile, which Minneapolis-Honeywell are producing for the U.S. Navy. Its name symbolises either anti-submarine rocket or atomic submarine rocket and it is an underwater-to-underwater missile, Fired from a submerged submarine, it completes most of its trajectory through the air, before re-entering the water and seeking its target by acoustic homing.

NAVAL ORDNANCE TEST STATIONS

INYOKERN, PASADENA AND CHINA LAKE, CALIFORNIA.

The Naval Ordnance Test Station at China Lake was responsible for the development of the Sidewinder and Diamondback air-to-air missiles, which are described under the "Philco" entry in this section of "All the World's Aircraft". It is also the prime contractor for the Rat missile.

Another N.O.T.S. product is the Hopi air-to-surface missile, of which brief details are given hereafter.

THE HOPI.

Few details are available of this weapon which is being developed by the Naval Ordnance Test Station at Inyokern. It is reported to be a medium-range stand-off bomb with the ability to carry a small thermonuclear warhead.

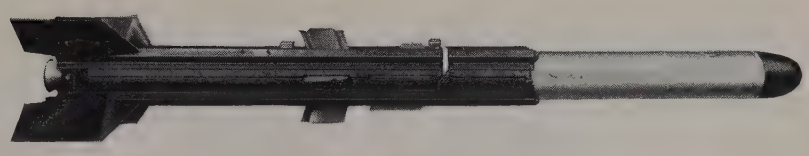
THE RAT.

Rat (Rocket-Assist Torpedo) is an anti-submarine weapon built around a standard homing torpedo. It can be air-launched, but will normally be fired from simple launchers mounted on the sides of existing 5-in. gun-turrets on escort vessels, and was scheduled to enter service with the U.S. Navy by the end of 1958.

The airframe, mounted on the rear of the torpedo, comprises an Allegany Ballistic Laboratory solid-propellent rocket motor, small cruciform pre-planes, cruciform tail surfaces and a two-stage parachute system. Guidance consists simply of aiming the missile by means of the ship's standard fire control system.

In a typical operation, the ship would detect and track an enemy submarine by asdic. Its fire control system would then train and elevate the launcher, after which Rat would be fired on a ballistic trajectory. Nearing the target, the airframe would separate, deploying the first-stage parachute to slow the missile.

Next, the first parachute would separate, opening a larger parachute which would be discarded with the nose-cap as Rat entered the water. The missile would then circle in a search pattern until its acoustic homing system picked up the sound of the enemy submarine, after which it would pursue and ram its target. Rat will not home on its launching ship.



The Rat anti-submarine weapon.

DIMENSIONS.—
Length 16 ft. (4.88 m.).
Body diameter approx. 1 ft. 3 in. (0.38 m.).
Span of tail-fins approx. 2 ft. 6 in. (0.76 m).

WEIGHT.—
Launching weight 450 lb. (205 kg.).

PERFORMANCE.—
Range 5 miles (8 km.).

NORTH AMERICAN

NORTH AMERICAN AVIATION, INC. MISSILE DEVELOPMENT DIVISION

HEAD OFFICE: 12214 LAKEWOOD BOULEVARD, DOWNEY, CALIFORNIA.

Officers: See "Aircraft" section.

North American were engaged for almost ten years on development of a ramjet-powered supersonic intercontinental missile known as the XSM-64 Navaho; and although the contract for this weapon was abandoned in 1957, it has since been fired successfully. Components of the Navaho weapon system are being put to other uses, and aerodynamic and design data resulting from the programme are contributing greatly to the current development of the GAM-77 Hound Dog missile, the F-108 interceptor and the B-70 Valkyrie bomber. There is also a project for using Navaho-type boosters to put the X-15 research aircraft into a satellite orbit.

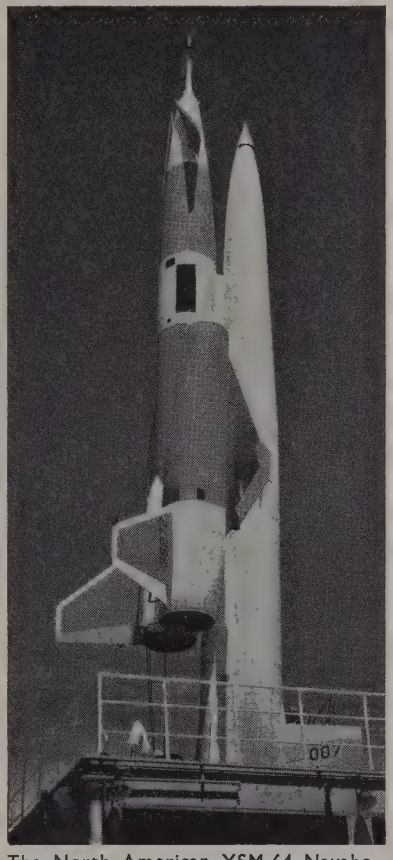
In addition to their work on the Hound Dog, North American are a member of the Boeing team that is producing one of the competitive design studies for the U.S.A.F.'s Dyna-Soar rocket-boosted glider project. The company's Rocketdyne and Autonetics Divisions are playing a major rôle on other important U.S. weapon programmes.

THE NAVAHO.

U.S.A.F. designation: XSM-64 (WS-104).

Although production of the operational Navaho was abandoned in the latter half of 1957, there has since been at least one successful firing and the Navaho programme continues to contribute to the development of subsequent missiles, piloted aircraft and other projects. As an example, its Autonetics inertial guidance system was used in slightly modified form for the under-the-Pole voyages of the submarines *Nautilus* and *Skate* in the Summer of 1958.

The aerodynamics and actual components of the Navaho were flight-tested for many hours at high supersonic speeds by thirteen North American X-10 recoverable test vehicles, which were described and illustrated in the 1957-58 edition of this work. They were followed by twelve experimental Navaho missiles, the first of which was fired towards the end of 1956. The first successful firing was on August 12, 1957.



The North American XSM-64 Navaho.

The configuration of the complete weapon system was unique, in that Navaho was carried pick-a-back on a huge booster at take-off.

TYPE.— Surface - to - surface experimental guided weapon.

WINGS.—Cantilever mid-wing monoplane of delta planform. Wings, mounted on rear of body, have considerable dihedral. Small pivoted wing-tip control surfaces.

BODY.—Basically cylindrical all-metal structure with nacelles for ramjet engines built on to sides of rear body.

TAIL SURFACES.—Tail-first design. Pivoted fore-plane control surfaces at nose. Twin stabilisers, with elevators, mounted on rear of engine nacelles.

POWER PLANT.—Two 48 in. (1,220 mm.) Curtiss-Wright RJ47 ramjet sustainers, each giving more than 40,000 lb. (18,000 kg.) thrust. One Rocketdyne three-chamber liquid-propellent booster (liquid oxygen and alcohol) with total thrust of approximately 400,000 lb. (180,000 kg.).

GUIDANCE.—Inertial system developed by North American Autonetics Division.

WARHEAD.—Intended to carry thermonuclear warhead.

DIMENSIONS AND WEIGHTS.—
No details available.

PERFORMANCE.—
Cruising speed Mach 3.
Designed range 5,000 miles (8,000 km.).

THE HOUND DOG.

U.S.A.F. designation: GAM-77.

Intended as a long-range successor to the Rascal stand-off bomb, the Hound Dog will have a range of several hundred miles and will be carried initially by the B-52G Stratofortress bomber.

North American's Missile Development Division was chosen as prime contractor in a design competition for which twelve companies submitted tenders; and the Hound Dog is believed to follow closely the configuration of the Navaho intercontinental bombardment missile, with a tail-first airframe and ramjet engines.

NORTHROP

NORTHROP AIRCRAFT, INC.

HEAD OFFICE: BEVERLY HILLS, CALIFORNIA.

Officers: See "Aircraft" section.

In addition to its rôle as a manufacturer of manned military aircraft, Northrop has been engaged on the development and production of guided missiles since 1946. Major product of this programme is the SM-62 Snark, the first intercontinental guided weapon to be assigned to operational units of the U.S.A.F. Strategic Air Command.

Northrop is engaged in work on other types of missile, including the Raytheon Hawk, and its Radioplane Division (which see) is also carrying out extensive research and development in the guided weapon and target drone field.

THE SNARK.

U.S.A.F. designation: SM-62.

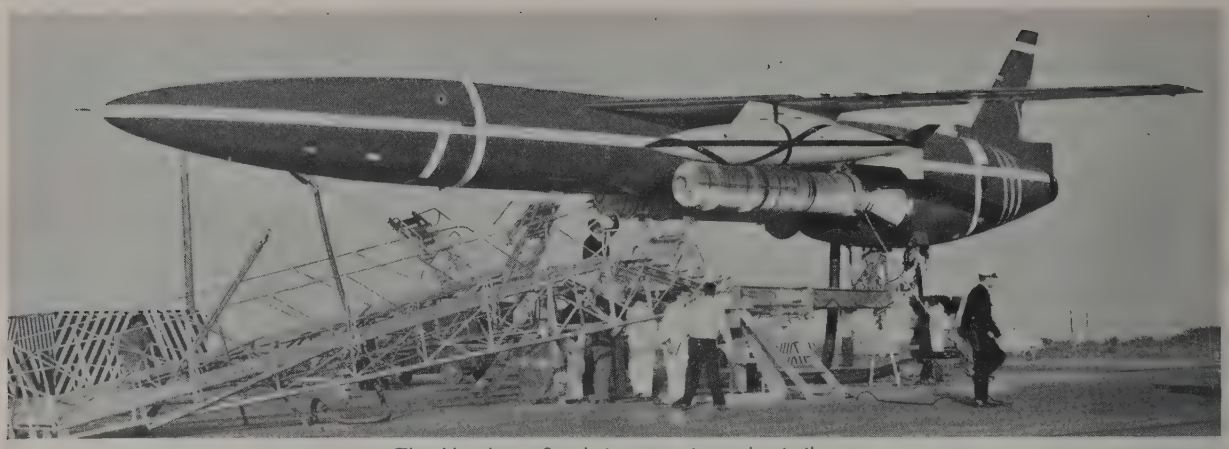
Only missile with intercontinental range in operational service outside Russia in 1958, the Snark is a turbojet-powered weapon of high-wing monoplane configuration.

Intended to deliver a nuclear warhead over very long distances, the Snark is launched from a zero-length ramp with the aid of two very powerful booster rockets. It achieves its maximum range when cruising at 55,000-60,000 ft. (16,750-18,300 m.), but can be set to fly at low levels to elude the enemy's radar defences when a shorter range is adequate.

Snark is fitted with a jettisonable warhead, which is blown clear of the airframe during the final supersonic dive on to the target. Its unjammable inertial guidance system enables it to be operated by day or night in all weathers, and it is designed to be air-transportable, with its ground support equipment, in C-124 and C-133 transport aircraft.

During tests from the U.S.A.F.'s Missile Test Center at Cape Canaveral, Florida, Snarks have several times flown the full 5,000 mile (8,000 km.) length of the firing range, to hit a pre-determined ocean target near Ascension Island.

More than 50 flights had been completed from Cape Canaveral by the Spring



The Northrop Snark intercontinental missile.

of 1958, with successful results even when the missiles were deliberately launched off course to test the efficiency of their guidance system and subjected to electronic countermeasures *en route*.

Snark became operational at launching sites in the northern tier of states in the U.S.A. during 1958, as a result of initial production contracts placed in the Summer of 1957. Normally each squadron will be equipped with three mobile launchers.

TYPE.—Surface-to-surface guided weapon.

WINGS.—High-wing cantilever monoplane, set well back on body. Sharply-swept wings of thin section, with "sawtooth" leading-edges. Elevons on trailing-edges. Wings removable for transport.

BODY.—Cylindrical all-metal structure, with ventral air intake.

TAIL SURFACES.—Vertical fin only.

POWER PLANT.—One Pratt & Whitney J57 turbojet sustainer (11,000 lb.=4,990 kg.) s.t. in rear of body. Two Aerojet-General solid-propellent jettisonable booster rockets, each giving 33,000 lb. (15,000 kg.) s.t. Two external fuel tanks can be carried on under-wing pylons.

GUIDANCE.—Northrop inertial and celestial guidance system.

WARHEAD.—Nuclear type.

DIMENSIONS.—
Length 69 ft. (21 m.).
Span of wings 42 ft. (12.80 m.).
Height 15 ft. (4.57 m.).

WEIGHT.—
Launching weight approx. 50,000 lb. (22,700 kg.).

PERFORMANCE.—
Cruising speed Mach 0.94.
Range at 60,000 ft. (18,300 m.) 6,300 miles (10,140 km.).
Range at S/L 2,000 miles (3,220 km.).

PHILCO

PHILCO CORPORATION.

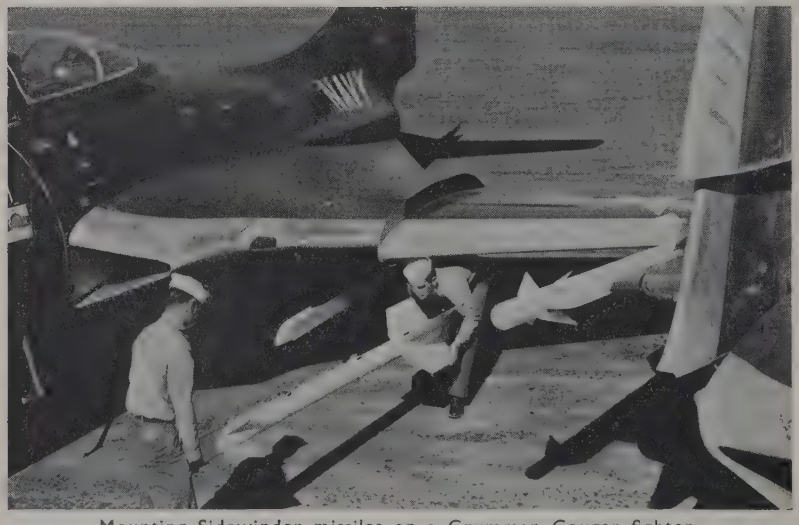
GOVERNMENT AND INDUSTRIAL DIVISION: 4,700 WISSAHICKON AVENUE, PHILADELPHIA 44, PA.

Philco are responsible for production of the Sidewinder air-to-air missile which was developed by the Naval Ordnance Test Station at China Lake, California. By 1958 they had delivered several thousand rounds to the U.S. Navy and U.S.A.F., and had received a contract to supply further quantities to arm jet-fighter squadrons of the Royal Canadian Navy and the Royal Australian Air Force.

The company also manufactures many components for the Convair Terrier surface-to-air missile; and it is expected that Philco will become prime contractor for an improved version of the Sidewinder, known as the Diamondback.

THE DIAMONDBACK.

Diamondback is reported to be a development of the Sidewinder infra-red air-to-air missile, with increased range and performance. It is currently under development at the Naval Ordnance Test Station, China Lake, California.



Mounting Sidewinder missiles on a Grumman Cougar fighter.

THE SIDEWINDER.

U.S. Navy designation: AAM-N-7.

U.S.A.F. designation: GAR-8.

One of the simplest and cheapest guided weapons yet produced in quantity, the Sidewinder air-to-air missile was developed by the N.O.T.S. at China Lake between 1948 and 1952 and has since been in continual production by Philco and General Electric, for both the U.S. Navy and the U.S.A.F.

Sidewinder is claimed to have less than two dozen moving parts and no more electronic components than a domestic radio. Yet it is highly manoeuvrable and has given approximately 70% direct hits on target drones when used in its training form, without warhead.

TYPE.—Air-to-air guided weapon.

WINGS.—None.

BODY.—Cylindrical aluminium structure.

TAIL SURFACES.—Cruciform fixed tail fins, indexed in line with cruciform control surfaces on nose.

POWER PLANT.—Solid-propellent sustainer, 75 in. (1.90 m.) long and with a burning time of 2 sec., manufactured by the Hercules Powder Company. No booster.

GUIDANCE.—Philco infra-red (heat-seeking) unit behind spherical glass nose.

WARHEAD.—5 lb. (2.27 kg.) high-explosive charge aft of control surfaces, with Honeywell proximity fuse, lethal up to 35 ft. (10.7 m.) radius, and contact fuses at tips of tail surfaces.

DIMENSIONS.—
Length 9 ft. 5 in. (2.87 m.).
Body diameter 4½ in. (0.11 m.).
Span of fins 1 ft. 7 in. (0.48 m.).

WEIGHT.—
Firing weight 155 lb. (70 kg.).

PERFORMANCE.—
Speed at burn-out Mach 2.5.
Range at S/L approx. 3,500 ft. (1,070 m.).
Range at 50,000 ft. (15,250 m.) 11,000 ft. (3,350 m.).

RADIOPLANE

RADIOPLANE DIVISION OF NORTHROP AIRCRAFT, INC.

DIVISION HEAD OFFICE: VAN NUYS, CALIFORNIA.

Officers: See "Aircraft" section.

Radioplane, in addition to its work as America's principal manufacturer of target drones, is engaged on research and development in the guided missile field, under U.S.A.F. prime contracts.

The only missile with which the company has been associated publicly is the air-to-surface Crossbow, which had reached the evaluation stage by the end of 1957, but was in danger of being abandoned at that time through lack of money for further development.

THE CROSSBOW.

U.S.A.F. designation: GAM-67.

Few details of this air-launched weapon are available, except that it is winged and is powered by a small turbojet. Prototypes are fitted with Bendix-Pacific telemetering equipment for evaluation at Holloman Air Force Base.

Crossbow is believed to be fitted with a Westinghouse J81 (Rolls-Royce Soar) turbojet, giving a level speed of 575 m.p.h. (925 km.h.), and to carry equipment which enables it to home on enemy radar sites as a bomber defence weapon.

RAYTHEON

RAYTHEON MANUFACTURING COMPANY.

MISSILE SYSTEMS HEADQUARTERS DIVISION: 50 WINTER STREET, WALTHAM, MASSACHUSETTS.

Raytheon hold several prime contracts for guided weapon research, development and production, but the only ones of which details have been given concern the Hawk surface-to-air missile and the air-to-air Sparrow III, of which details are given hereafter.

THE HAWK.

U.S. Army designation: XM-3.

This comparatively small, surface-to-air guided weapon is intended to complement the Nike-Hercules by dealing principally with low-flying enemy raiders. Its radar homing system is claimed to be able to pick out the reflection from a moving target at low altitudes from a mass of signals reflected by ground objects such as hills, buildings and tree tops.

All components of the Hawk missile system are designed to be easily transportable by fixed-wing aircraft, helicopter or land vehicle. They include a tracked loader, which can collect the missiles three at a time and deliver them to the amphibious triple launcher.

Initial production of the Hawk began in 1957, with Northrop Aircraft as main sub-contractors for airframe components and support equipment such as the loader and launcher. It is being assigned for both mobile use by the U.S. Army and Marine Corps and as a fixed-base defence weapon, with initial firing sites in the Washington, Baltimore and New York City areas. Each battery of 36 missiles requires some 40 acres for emplacement, using underground storage facilities. Fire control can be co-ordinated by the Martin Missile Master system.

TYPE.—Surface-to-air guided weapon.
WINGS.—Fixed cruciform wings of sharply-swept long-chord planform, each comprising a one-piece steel casting. Hinged control surface on trailing-edge of each wing.
BODY.—Cylindrical all-metal structure. Skin of rear portion forms wall of solid-propellent motor.
TAIL SURFACES.—None.
POWER PLANT.—One Aerojet-General two-stage solid-propellent motor, of which the first, rapid-burning portion acts as a booster.
GUIDANCE.—Raytheon semi-active radar-homing system.
WARHEAD.—Variety of high-explosive warheads, produced by Picatinny Arsenal.
DIMENSIONS.—
Length 16 ft. 4 in. (4.98 m.).
Body diameter 1 ft. 2⅛ in. (0.37 m.).
Span of wings 4 ft. (1.22 m.).
WEIGHT.—
Firing weight 1,200 lb. (545 kg.).
PERFORMANCE.—
Speed at burn-out above Mach 2.8.
Max. slant range 22 miles (35 km.).



The Raytheon Hawk.

THE SPARROW III.

U.S. Navy designation: AAM-N-6.

Although similar in configuration to the Sparrow I missile developed by the U.S. Navy Bureau of Aeronautics and the Sperry Gyroscope Company, Sparrow III has been entirely redesigned and is claimed to be the most advanced weapon of its kind. Its body is larger in diameter than that of the original version and it has a new all-weather radar homing system of Raytheon design. The solid-propellent motor is manufactured by Aerojet-General.

Raytheon are producing the Sparrow III in the National Industrial Reserve Aircraft Factory at Bristol, Tennessee, the management of which they took over from Sperry in 1957.

DIMENSIONS (approx.).—
Length 12 ft. (3.66 m.).
Body diameter 9 in. (0.23 m.).
Span of wings 3 ft. 3 in. (0.99 m.).
WEIGHT.—
Launching weight 350 lb. (160 kg.).
PERFORMANCE.—
Speed at burn-out Mach 2.5-3.
Range up to 8 miles (13 km.).


Sparrow III missiles under the wings of a McDonnell Demon fighter.

REPUBLIC

REPUBLIC AVIATION CORPORATION.

GUIDED MISSILES DIVISION: JERICHO TURNPIKE, MINEOLA, LONG ISLAND, NEW YORK.

Officers: See "Aircraft" section.

Republic first entered the guided missile field in 1944, but it was not until the first flight of a Terrapin research rocket in September 1956, that any details of its work were released.

Current projects under development at the company's Guided Missiles Division include an air-to-air missile system, a fire control system to guide an air-to-surface weapon towards the target and a missile that is claimed to be more advanced than an Earth satellite.

THE TERRAPIN.

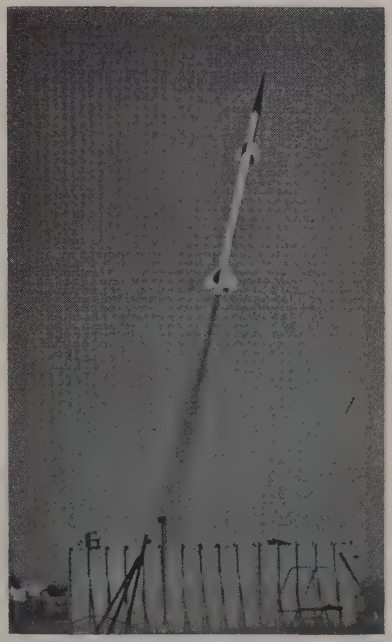
This extremely simple high-speed research rocket was designed and produced by Republic's Guided Missiles Division in collaboration with the University of Maryland. Intended for upper atmosphere exploration, it is a low-cost device carrying special miniaturised instrumentation weighing only 6 lb. (2.7 kg.), which was developed at the University.

Terrapin is a two-stage rocket, fired from a collapsible zero-length launcher. The first-stage motor was designed by the Allegany Ballistics Laboratory and is a modified Deacon solid-propellent rocket. The second stage comprises a Thiokol T-55 solid-propellent motor.

In the first firing from the NACA proving ground at Wallops Island, Virginia, the first-stage motor thrust the Terrapin to 10,000 ft. (3,050 m.) in six seconds, at a speed of 1,900 m.p.h. (3,060 k.m.h.). The first stage then separated and the missile coasted to 40,000 ft. (12,200 m.) before the second-stage motor was fired, thrusting the Terrapin to 50,000 ft. (15,250 m.) at a maximum speed of Mach 5.8, equivalent to approx. 3,800 m.p.h. (6,115 km.h.). The missile coasted on up to a height of 80 miles (129 km.), relaying measurements of primary cosmic radiation, temperatures, spin of the rocket and acceleration experienced by internal equipment. Duration of flight was 5.6 min. and temperatures up to 1,000 deg. F. were recorded.

Republic are producing several dozen Terrapins and have completed preliminary design of a third-stage rocket that would make possible research up to a height of at least 200 miles (320 km.).

DIMENSIONS.—
Length less than 15 ft. (4.57 m.).
Body diameter 6¼ in. (0.16 m.).
WEIGHT.—
Firing weight 224 lb. (102 kg.).


The Republic Terrapin.

SPERRY

SPERRY GYROSCOPE COMPANY, DIVISION OF SPERRY RAND CORPORATION.

HEAD OFFICE: GREAT NECK, NEW YORK

In addition to developing and producing electronic equipment, such as the guidance systems for the Terrier and Talos surface-to-air weapons, Sperry are prime contractors for the air-to-air Sparrow I and the new solid-propellent surface-to-surface Sergeant missile. Details of these weapons are given hereafter.

THE SERGEANT.

Sergeant was designed and developed by the Jet Propulsion Laboratory of the California Institute of Technology as a replacement for the Firestone Corporal surface-to-surface missile. It offers considerable logistical and operational advantages over the earlier weapon by reason of its solid-propellent motor and inertial guidance system. All units of support equipment and the missile itself are transportable by air and standard U.S. Army vehicles.

Production of the Sergeant and its ground equipment is centred in Sperry's Salt Lake City plant, under a prime contract awarded in 1956. It was expected to enter service during 1958.

TYPE.—Surface-to-surface guided weapon.
WINGS.—None.
BODY.—Cylindrical all-metal structure.
TAIL SURFACES.—Fixed cruciform tail-fins of long-chord delta planform, with small control surfaces hinged to trailing-edges.
POWER PLANT.—One Thiokol solid-propellent sustainer, giving over 50,000 lb. (22,700 kg.) s.t. No booster.
GUIDANCE.—Inertial system by Sperry.
WARHEAD.—Nuclear or high-explosive, as required.



The Sergeant bombardment missile.

DIMENSIONS (approx.).—
Length 30 ft. (9.14 m.).
Body diameter 3 ft. (0.91 m.).
Span of fins 7 ft. 8 in. (2.33 m.).
WEIGHT (estimated).—
Firing weight 20,000 lb. (9,000 kg.).
PERFORMANCE (estimated).—
Range over 100 miles (160 km.).

THE SPARROW I.

U.S. Navy designation: AAM-N-2.

Development of the Sparrow air-to-air missile for the U.S. Navy Bureau of Aeronautics began as Sperry's project "Hot Shot" in 1945. The first test firings were made two years later and the developed AAM-N-2 was flown in 1951. It became operational with the U.S. Atlantic and Pacific fleets in 1955, and several thousand Sparrow I missiles were produced subsequently by Sperry in a Naval Industrial Reserve Aircraft plant at Bristol, Tennessee.

Sparrow I went out of production late in 1956 and the Bristol plant is now being operated by Raytheon as the production centre for the developed Sparrow III.

TYPE.—Air-to-air guided weapon.
WINGS.—Pivoted cruciform wings at mid-point of body. Each wing is a solid machining, of delta planform.
BODY.—Cylindrical all-metal structure.
TAIL SURFACES.—Fixed cruciform fins of delta planform, indexed in line with wings at tail of missile.
POWER PLANT.—Aerojet-General solid-propellent sustainer. No booster.
GUIDANCE.—Beam-riding, with initial guidance after launching by inertial elements.
WARHEAD.—High-explosive type.
DIMENSIONS.—
Length 12 ft. 6 in. (3.81 m.).
Body diameter 8 in. (0.20 m.).
Span of wings 2 ft. 3 in. (0.69 m.).
WEIGHT.—
Launching weight 295 lb. (134 kg.).
PERFORMANCE.—
Speed at burn-out Mach 2.8.
Range up to 5 miles (8 km.).

TEMCO

TEMCO AIRCRAFT CORPORATION.

HEAD OFFICE AND WORKS: P.O. Box 6191, DALLAS 22, TEXAS.

Officers: See "Aircraft" section.

It was announced by the U.S. Navy early in 1958 that Temco has complete responsibility for an air-to-surface weapon system known as the Corvus, including any necessary modifications to aircraft carrying the missile, and development of ground handling, test and check-out equipment and packaging. All available details of the weapon follow.

THE CORVUS.

Little information on the Corvus has yet been released, except that it will be an air-to-surface stand-off weapon for use by the U.S. Navy and Marine Corps. It will be powered by a Reaction Motors Patriot liquid-propellent rocket engine and will have a guidance system by W. L. Maxson Corporation of New York and Texas Instruments of Dallas.

Corvus is reported to be a large, long-range winged missile.

WESTERN ELECTRIC

WESTERN ELECTRIC COMPANY, INC.

HEAD OFFICE: 195 BROADWAY, NEW YORK, N.Y.

Vice-President, Sandia Operations: James W. McRae.

Vice-President, Defense Projects Division: W. E. Burke.

Western Electric are prime contractors for the entire Nike series of surface-to-air weapons, which have constituted a major anti-aircraft defence system in the United States since December 1953, when the first Nike-Ajax site became operational.

The basic research that led to the original Nike-Ajax was conducted by Bell Telephone Laboratories, who are currently responsible for prime research and development of Nike-Zeus. Douglas Aircraft are responsible for production of Nike airframes and launching components, in their Charlotte, N.C., plant.

THE NIKE-AJAX.

U.S. Army designation: SAM-A-7.

First surface-to-air anti-aircraft missile to enter service in the United States, the Nike-Ajax is also standard equipment of the U.S. forces in Greenland, Alaska and Germany. More than 10,000 have been delivered, but they are now being superseded by the greatly-improved Nike-Hercules.

Development of Nike-Ajax was started by Bell Telephone Laboratories in 1945 and more than 1,500 rounds were fired before the weapon became operational. The initial plan was to utilise Nike-Ajax to defend 40 major cities and targets in the continental United States and each site consists of a battery of launchers, many of which are stowed horizontally under the ground until needed for action.

Guidance is fairly primitive, consisting of a radar command system in which one radar beam is locked on the target, while another flies the missile on a collision course calculated by a ground computer. When the missile is just under the nose of the target, its warhead is detonated by a command signal. The Nike weapon system is integrated with the overall SAGE (semi-automatic ground environment) network which controls and co-ordinates the complete U.S. air and ground anti-aircraft defence system, in conjunction with the Martin Missile Master which prevents duplication of attack or overlooking of any target by groups of Nike and Hawk batteries.

TYPE.—Surface-to-air guided weapon.
WINGS.—Fixed cruciform wings of long-chord delta planform, mounted towards rear of body.
BODY.—Cylindrical all-metal structure.
TAIL SURFACES.—Tail-first design. Pivoted cruciform fore-planes on nose indexed in line with wings.
POWER PLANT.—Bell Aircraft (originally Aerojet-General) liquid-propellent (nitric acid and kerosene) sustainer, developing 2,600 lb. (1,180 kg.) s.t. for 35 sec. Hercules Powder Company solid-propellent jettisonable booster mounted in tandem in a Goodyear-manufactured casing fitted with three large stabilising fins.
GUIDANCE.—Radar command system by Western Electric.
WARHEAD.—High-explosive type, with electro-mechanical fusing by Elgin National Watch Company.
DIMENSIONS.—
Length with booster 34 ft. 10 in. (10.61 m.).
Length without booster 21 ft. (6.40 m.).
Body diameter 1 ft. (0.30 m.).
Span of wings 4 ft. (1.22 m.).
WEIGHT.—
Firing weight over 2,000 lb. (900 kg.).
PERFORMANCE (estimated).—
Speed at burn-out Mach 2.3.
Slant range 10-25 miles (16-40 km.).

THE NIKE-HERCULES.

U.S. Army designation: SAM-A-25.

Known originally as Nike-B, this weapon has substantially greater speed and range than the Nike-Ajax, which it has superseded in production. Its guidance system is considerably more advanced and it is more manoeuvrable at height, offering the ability to destroy any existing bomber before the latter could release a free-fall bomb against a target defended by Nike-Hercules batteries.

Development of Nike-Hercules was started in 1953 by the U.S. Army Ordnance Corps, Bell Telephone Laboratories, Western Electric and Douglas Aircraft. Western Electric are prime contractors for its production and are manufacturing the weapon's guidance and control equipment at their Burlington and Winston-Salem plants in North Carolina. Douglas are building the airframes and launching components, initially at Santa Monica, but with series production centred in their Charlotte, N.C., plant.

Early Nike-Hercules development rounds had liquid-propellent sustainers, but these have now been replaced by solid-propellent motors. The tandem booster



The Nike-Ajax.

consists of four Nike-Ajax boosters clamped together.

Modifications to existing ground equipment at Nike-Ajax launching sites make it possible for Nike-Hercules to be integrated into batteries of the earlier weapon. Both types can then be fired together from the same site, the equipment changes adding to the effectiveness of the Nike-Ajax. First sites so modified are in the north-eastern and mid-west United States.

TYPE.—Surface-to-air guided weapon.

WINGS.—Fixed cruciform wings of very long chord, with small control surfaces hinged behind the trailing-edges.

BODY.—Circular-section all-metal structure.

TAIL SURFACES.—None.

POWER PLANT.—Thiokol solid-propellent sustainer. Four-barrel Hercules Powder Company solid-propellent jettisonable booster mounted in tandem, with four large stabilising fins indexed in line with wings.

GUIDANCE.—Radar command system by Western Electric, probably with radar homing.

WARHEAD.—Choice of nuclear or high-explosive fragmentation type with electro-mechanical fusing and detonating by General Electric and W. L. Maxson.

DIMENSIONS.—
Length with booster 41 ft. 6 in. (12.65 m.).
Length without booster 27 ft. (8.23 m.).
Body diameter 2 ft. 1 in. (0.64 m.).
Span of wings 6 ft. 2 in. (1.88 m.).

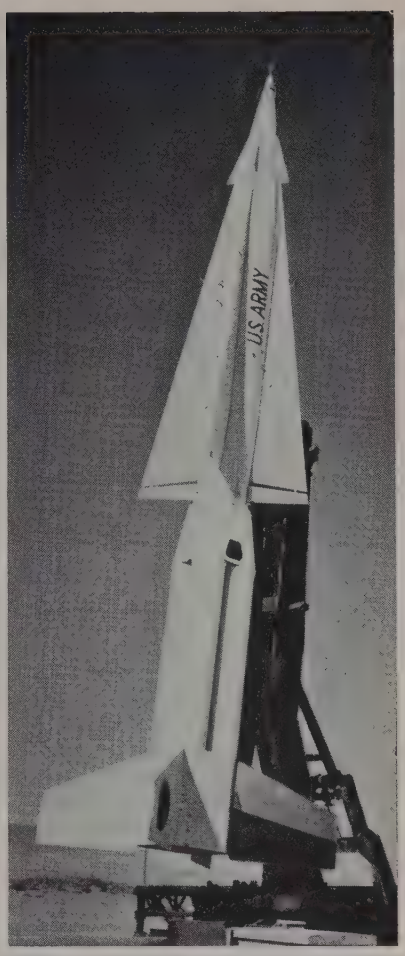
WEIGHT (estimated).—
Firing weight 5,000 lb. (2,270 kg.).

PERFORMANCE (estimated).—
Speed at burn-out Mach 3.3.
Slant range 75 miles (120 km.).

THE NIKE-ZEUS.

This anti-ballistic missile defence system is said to have reached an advanced stage of development. It is reported to embody an electro-acoustical detection system which picks up electromagnetic disturbances as the attacking ballistic missile re-enters the atmosphere.

Bell Telephone Laboratories are responsible for research and development, with Western Electric as prime systems contractor and Douglas as the airframe manufacturer. Range with a nuclear warhead will be up to 200 miles (320 km.).



The Nike-Hercules.

WESTINGHOUSE

WESTINGHOUSE ELECTRIC CORPORATION.

HEAD OFFICE: P.O. Box 868, PITTSBURGH 30, PA.

AIR ARM DIVISION: P.O. Box 476, FRIENDSHIP INTERNATIONAL AIRPORT, BALTIMORE 3, MARYLAND.

Through its various operating divisions, the Westinghouse Electric Corporation is contributing to several major U.S. missile projects, including the Bomarc surface-to-air weapon and the Polaris surface-to-surface ballistic missile. It is also developing an anti-submarine weapon known as Astor, of which brief details are given hereafter.

THE ASTOR.

Astor, standing for Anti-Submarine Torpedo Ordnance Rocket, is one of several nuclear warhead anti-submarine devices now under development for the U.S. Navy. Little information is available except that it is based on the Mk. 18 torpedo.

MISCELLANEOUS U.S. MISSILES

ARCON.

This is one of many small and inexpensive research rockets produced in the United States for limited scientific purposes. It is a single-stage vehicle, able to carry a 40 lb. (18 kg.) payload to a height of 70 miles (112 km.).

ASP.

Another small research rocket, Asp can carry a 25 lb. (11 kg.) payload to a height of 40 miles (64 km.). It is powered by an Arrow II solid-propellent motor.

EXPLORER.

The series of Earth satellites launched by the U.S. Army as part of the United States International Geophysical Year research programme each bear the name Explorer.

A four-stage launching vehicle is used to put each Explorer satellite into orbit. The first stage consists of a Redstone ballistic missile, modified to burn a hydrazine-based compound instead of alcohol, to produce a thrust of about 75,000 lb. (34,000 kg.).

The three following stages are contained in a barrel-like cylinder. The second stage is a cluster of eleven Recruit solid-propellent rockets, surrounding the third stage, a triangle of three similar rockets. Directly in the centre is the fourth stage, comprising a single solid-propellent rocket with an instrument package "satellite" mounted on its nose. The casing of this stage remains attached to the instrument package during orbit.

After launching, the first-stage rocket burns for about 160 sec., carrying the vehicle to a speed of 6,800 m.p.h. (10,950 km.h.) and an altitude of 53 miles (85 km.). When this stage is expended, the vehicle coasts, arching over until it reaches an altitude of 200-220 miles (320-355 km.), just under seven minutes after firing. The second-stage rockets are then ignited by radio control. After this stage has burned out, it is detached. So in turn is the third stage, leaving the fourth stage to accelerate the satellite into orbit at about 18,000 m.p.h. (29,000 km.h.).

Following are details of the Explorer satellites launched up to the time of writing:

Explorer I (1958-Alpha).—Launched January 31, 1958, and expected to remain in orbit for about seven years. Initial perigee 220 miles (355 km.) above the Earth, apogee 1,590 miles (2,560 km.). Contains approx. 11 lb. (5 kg.) of instruments designed to gather and transmit data on cosmic rays, meteorites and orbital temperatures. Made initial discovery of belt of intense radiation beginning some 600 miles (965 km.) above the Earth.

Explorer II.—Similar to Explorer I. Failed to enter orbit.

Explorer III (1958-Gamma).—Similar to Explorer I, with addition of small magnetic tape recorder able to release two hours of stored data on cosmic ray bombardment in five seconds as satellite passed over ground station. Launched March 26, 1958. Remained in orbit approx. three months. Initial perigee 117 miles (188 km.), apogee 1,700 miles (2,735 km.). Dimensions as Explorer I. Total weight 31 lb. (14 kg.).

Explorer IV (1958-Epsilon).—Launched July 26, 1958. Equipped with four radiation counters and two radio transmitters. Initial perigee 163 miles (262 km.), apogee 1,373 miles (2,210 km.). Total weight approx. 38.5 lb. (17.5 kg.). Initial orbital time 110.28 min.

Explorer V.—Launched August 24, 1958. Failed to orbit.



Explorer IV

FARSIDE.
This high-altitude research rocket was designed to avoid as far as possible the retarding effect of the atmosphere by being launched from a balloon at a height of 100,000 ft. (30,500 m.). It consists of ten solid-propellent motors mounted in four stages. The first stage comprises four Recruit rockets, with a single Recruit as the second stage, four Arrow II's as the third stage and a single Arrow II as the final stage. Launched above Eniwetok Atoll in the Pacific on October 21, 1957, it is estimated to have reached a height of 4,000 miles (6,440 km.).

IRIS.
A two-stage research rocket designed to carry a 100 lb. (45 kg.) payload to a height of 200 miles (320 km.).

KATIE.
Katie is reported to be an anti-shipping surface-to-surface rocket missile, launched from the 16 in. (400 mm.) guns of naval warships. It will have a nuclear warhead.

MINUTEMAN XSM-80.
Minuteman will be a three-stage solid-propellent ICBM, intended to replace in due course the liquid-propellent Atlas and Titan. It is in a very early stage of development, as contracts were not placed by the U.S.A.F. until the Summer of 1958.

Overall scientific responsibility for the project is held by Space Technology Laboratories, a division of the Ramo-Wooldridge Corporation until January 1, 1959, when it will become a separate corporation. Power plant development has been entrusted to Aerojet-General and Thiokol. The missile guidance and control system is being developed by the Autonetics division of North American Aviation. Boeing will be responsible for assembly and testing.



Farside rocket being prepared for launching.

NIKE-CAJUN.
About 50 Nike-Cajun research rockets were scheduled to be fired as part of America's I.G.Y. programme. Each consists of a Nike booster and a Cajun second stage, to carry about 60 lb. (27 kg.) of instruments to a height of 95 miles (153 km.). One of the main objectives was to measure water vapour distribution.

PIONEER.
Name given to the Thor-Able type of rocket (see below), which travelled 79,212 miles into space on October 11, 1958, but deviated from its course and failed to orbit the Moon, as hoped.

PLATO.
Little is known of this surface-to-air missile, except that its prime contractor is Sylvania Electric Products, Inc.

THOR-ABLE.
Thor-Able is one of the vehicles used by the U.S.A.F. for re-entry trials, and has been used successfully to retrieve complete missile nose-cones, some of which have carried living mice. It is also being utilised as the U.S.A.F.'s lunar probe vehicle, of which three launchings have been authorised by the U.S. Government. The first, on August 17, 1958, ended when the vehicle exploded 77 sec. after take-off from Cape Canaveral, Florida.

Overall responsibility for the lunar project is held by Space Technology Laboratories of Los Angeles, and the object is to put an 83.8 lb. (38 kg.) payload package into an orbit around the Moon. This package consists of an instrument container about 30 in. (0.76 m.) in diameter, mounted on a 3,000 lb. (1,360 kg.) s.t. Thiokol forward-firing solid-propellent rocket, so that the complete terminal rocket resembles a spinning top in shape.

Total height of the lunar probe Thor-Able is 88 ft. 1 in. (26.85 m.). The first stage is a standard Thor IRBM. The second stage has an Aerojet-General liquid-propellent engine giving 7,500 lb. (3,400 kg.) s.t. and is fitted with eight vernier rockets. The third stage is a 2,500 lb. (1,135 kg.) s.t. rocket developed originally by Allegany Ballistics Laboratory for the Vanguard Earth satellite project but never used for that purpose. It weighs 400 lb. (180 kg.) and carries the terminal rocket and payload package.

Instrumentation weighing 25 lb. (11 kg.) includes batteries with a life of one month, a telemetering system and a mechanical ground scanning device developed by the Naval Ordnance Test Centre, Inyokern, California.



Thor-Able III.

VANGUARD.

First mentioned in a White House statement in July 1955, Vanguard is America's original Earth satellite rocket project, developed by the U.S. Naval Research Laboratory. It is a three-stage vehicle, designed to put into orbit a fully-instrumented satellite weighing 21 lb. (9.5 kg.) and with a diameter of 20 in. (0.51 m.). At the time of writing, only one of several launching attempts had proved successful.

Launched on March 17, 1958, Vanguard I (1958-Beta) established in orbit a small test sphere measuring 6.4 in. (0.16 m.) in diameter and weighing 3.25 lb. (1.47 kg.). Its instrumentation included six solar batteries, mounted on its outer skin and designed to keep its telemetry transmitters in action for much longer than is possible with conventional batteries.

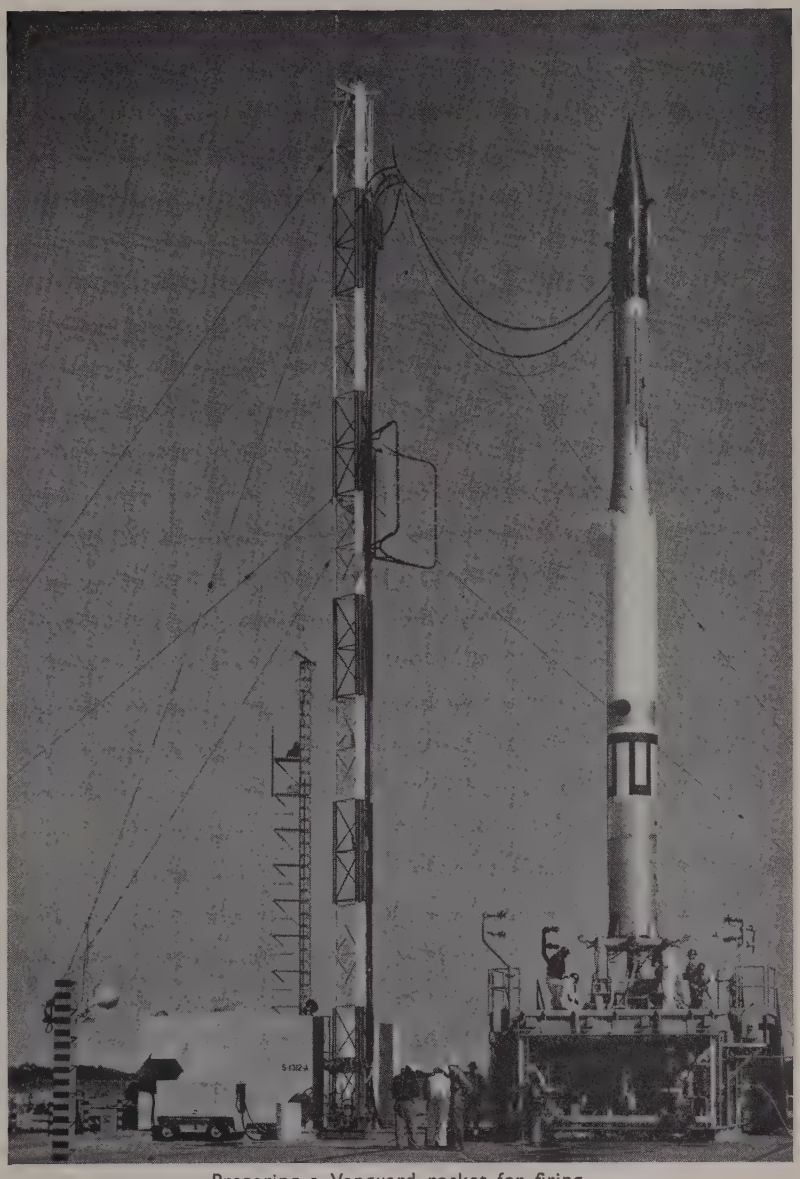
Vanguard I entered an elliptical orbit which varied initially from 400 miles (640 km.) to 2,500 miles (4,025 km.) above the Earth. Travelling at a speed of up to 18,400 m.p.h. (29,600 km.h.), it made a full 34,100 mile (54,880 km.) circuit each 135 min. It is expected to remain in orbit for 200 years.

The complete Vanguard vehicle is 72 ft. (22 m.) long and has a firing weight of 22,600 lb. (10,250 kg.). The first stage is a development of the Martin Viking research rocket with a General Electric liquid-propellent engine developing 27,000 lb. (12,250 kg.) s.t. for 142 sec. This motor is gimbal-mounted to provide directional control.

Stage two has an Aerojet-General liquid-propellent rocket of 7,500 lb. (3,400 kg.) s.t., also gimbal-mounted. The third stage is a 2,300 lb. (1,045 kg.) s.t. solid-propellent rocket, which carries the satellite on its nose. Guidance is provided by an inertial reference system in the second stage.

WAGTAIL.

Wagtail is reported to be an air-to-surface stand-off bomb, with Minneapolis-Honeywell guidance. Forward-firing rockets are said to slow it almost to a standstill after launching, before its sustainer fires, so that it can be programmed to climb over obstacles such as hills if launched from a bomber at very low altitude.



Preparing a Vanguard rocket for firing.

ALL THE WORLD'S AERO-ENGINES

(CORRECTED TO SEPTEMBER 30th, 1958)

ARRANGED IN TWO PARTS:

(1) GAS-TURBINE ENGINES
(2) PISTON ENGINES

PART I—GAS-TURBINE ENGINES

BELGIUM

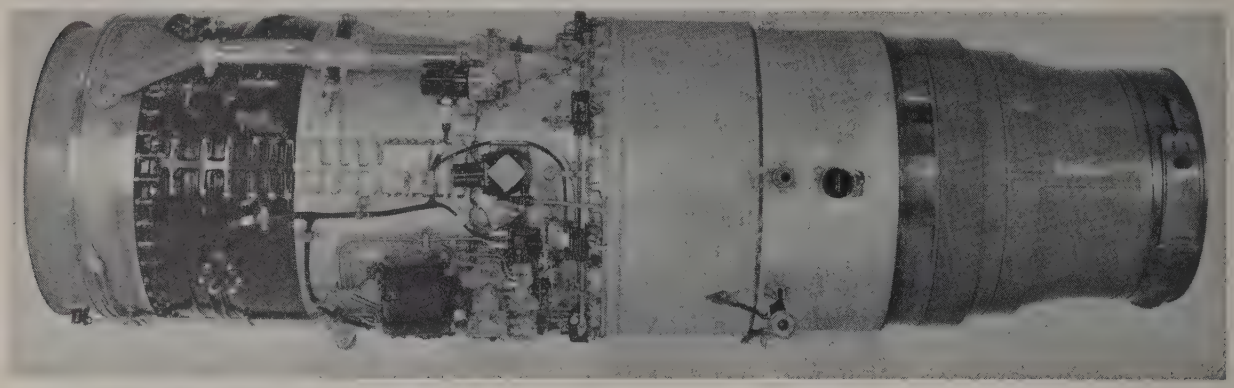
FN

FABRIQUE NATIONALE D'ARMES DE GUERRE, S.A.

HEAD OFFICE AND WORKS: HERSTAL-LEZ-LIÈGE.

This great armaments company undertook the manufacture under licence some years ago of Rolls-Royce Derwent turbojets for the Gloster Meteor fighters which were built in Belgium and the Netherlands. By the time FN ceased production of Derwents in 1955, it had delivered a total of more than 1,000 of these engines.

Meanwhile, it had begun the manufacture of Rolls-Royce Avon 100-series turbojets for the Hawker Hunter fighters which had superseded the Meteor in production in Belgium and the Netherlands. These engines have been followed by Avon 200-series turbojets for the latest version of the Hunter which is currently in production. A full description of the basic 100 and 200 Series Avons appears under "Rolls-Royce" in the British section of this work.



A Rolls-Royce RA.23 (200 Series) Avon built under licence by the Fabrique Nationale d'Armes de Guerre (FN).

THE BRITISH COMMONWEALTH

GREAT BRITAIN

ARMSTRONG SIDDELEY

ARMSTRONG SIDDELEY MOTORS LTD.

HEAD OFFICE AND WORKS : COVENTRY.

Directors : Sir Frank Spencer Spriggs, K.B.E., Hon. F.R.Ae.S. (Chairman), Sir Thomas Sopwith, C.B.E., Hon. F.R.Ae.S., H. Burroughes, F.R.Ae.S., H. T. Chapman, C.B.E., F.R.Ae.S., M.I.Mech.E. (Managing Director), W. F Saxton, M.B.E. (Deputy Managing Director), W. H. Lindsey, M.A., F.R.Ae.S. (Technical Director), J. E. Attwood (General Manager).

Prior to their entry into the gas-turbine field Armstrong Siddeley Motors had done some of the early experimental work on axial-flow compressors and blade forms, as well as manufacturing the R.A.E. research contra-flow unit in 1939 to the designs of Dr. Griffiths.

First Armstrong Siddeley gas-turbine to enter production was the Python turboprop which first ran and passed its acceptance test in 1945. The Python engine powers the Westland Wyvern S. Mk. 4 strike aircraft and has been described in earlier editions of "All the World's Aircraft."

The Sapphire turbojet has been in large-scale production for several years for the Hawker Hunter, Gloster Javelin and Handley Page Victor aircraft.

Research and development of the Sapphire are handled by the parent company at Coventry ; but its subsidiary, Armstrong Siddeley (Brockworth) Ltd., in Gloucestershire, is responsible for quantity production.

Other important engines are the Double Mamba, which powers the Fairey Gannet, and the Viper, which was evolved as a "short-life" engine but has since been developed as a conventional long-life engine and in its latter form powers the Hunting Percival Jet Provost trainer, the Saunders-Roe S-R.53, the Macchi M.B. 326, the Bell X-14 and an Ikarus ground attack aircraft.

Armstrong Siddeley is also developing a series of liquid-fuel rocket motors at its Rocket Division at Ansty, near Coventry. One of these powers the highly-successful Saunders-Roe Black Knight re-entry test vehicle.

In 1950 the Curtiss-Wright Corporation acquired the right to build Armstrong Siddeley gas-turbine engines in the United States and had produced approximately 11,000 J65 (Sapphire) turbojets by early 1958.

In 1953 a licence for the manufacture in France of the Viper long-life turbojet engine was acquired by Avions (now Générale Aéronautique) Marcel Dassault.

In May, 1957, it was announced that Armstrong Siddeley had acquired the licence to manufacture in Britain the auxiliary power gas-turbines and air turbine starters developed by the AiResearch Manufacturing Division of the Garrett Corporation of Los Angeles, U.S.A. It also has the licence to manufacture the German Maybach range of industrial, marine and railway diesel engines.

THE ARMSTRONG SIDDELEY SAPPHIRE SERIES 100.

The Sapphire engine is a turbojet with an axial-flow compressor and an annular combustion chamber of the Armstrong Siddeley vaporising type.

It was designed originally by Metropolitan-Vickers, Ltd., from whom full responsibility for further design, development and production was taken over by Armstrong Siddeley in 1948. As a result of running experience with the early versions, Armstrong Siddeley made a number of major design changes, which resulted in the ASSa.3 version.

Further extensive development led to a new family of Sapphires with important design changes, including a redesigned compressor. Known as the Series 200, these engines are described separately after the description of the Series 100 engine.

The following versions of the Series 100 Sapphire have been announced :—

ASSa.1. Initial Metropolitan-Vickers design. Rated at 7,000 lb. (3,175 kg.) s.t.

ASSa.2. Developed version rated at 7,380 lb. (3,347 kg.) s.t.

ASSa.3. First version incorporating results of Armstrong Siddeley running experience. Completed a 150-hour Service Type Test in November, 1951, at a sea level static maximum rating of 7,500 lb. (3,400 kg.) with a specific consumption of 0.91 lb./hr./lb. (0.91 kg./hr./kg.). Its current rating is 7,590 lb. (3,442 kg.).

ASSa.5. Special version of ASSa.6 for English Electric P.1A. Rated at 8,300 lb. (3,765 kg.) s.t. One version fitted with reheat.

ASSa.6. Development of ASSa. 3 with higher r.p.m. In May, 1952, passed the 150-hour Type Test at 8,300 lb. (3,770 kg.) s.t.

ASSa.12. Mechanically similar to ASSa. 6, but has cast turbine rotor blades which allow an increased turbine-inlet temperature, giving a rated thrust of 8,800 lb. (3,990 kg.) and specific fuel consumption of 0.91 lb./lb. s.t./hr. (0.91 kg./kg. s.t./hr.).

Dimensions and weight as for ASSa.6.

The Sapphire powers the Gloster Javelin, the Handley Page Victor B.Mk. 1 and the English Electric P.1A prototypes. One of the P.1A's has special reheated Sapphire ASSa.5 turbojets, and late models of the Javelin Mk. 7 and 8 also have a reheat installation.

The Sapphire has been produced in quantity in the United States, under the designation J65, by the Wright Aeronautical Corporation.

The following details apply specifically to the Sapphire ASSa.6, but are generally applicable to other Series 100 engines :—

TYPE.—Axial-flow Turbojet.

AIR INTAKE.—Annular type at front of engine.

COMPRESSOR.—Thirteen stage axial-flow, first three stages forming low-pressure section and last ten high-pressure section. 1,062 rotor blades secured by "fir-tree" roots in steel discs shrunk and dogged on hollow aluminium-alloy (MAT 101) drum. First three rows of blades are close-forged in S.62 stainless steel. From the fourth to seventh stage the blades are close-forged in aluminium alloy, machined only at root and tip. The last six stages are of stainless steel. One row of inlet guide vanes and all 652 stator blades (first seven rows stainless steel close-formed stampings ; last six in steel rough stampings) secured by dovetail roots in carrier rings which are split for ease of assembly in compressor case. First seven rows of stator blades are shrouded. Compressor shaft carried on ball-bearing (front) and single-row roller-bearing (rear). Compressor casing cast in top and bottom halves in L.51 aluminium alloy, bolted together. Compression ratio 7.26 : 1. Air mass flow 130 lb./sec. (59 kg./sec.).

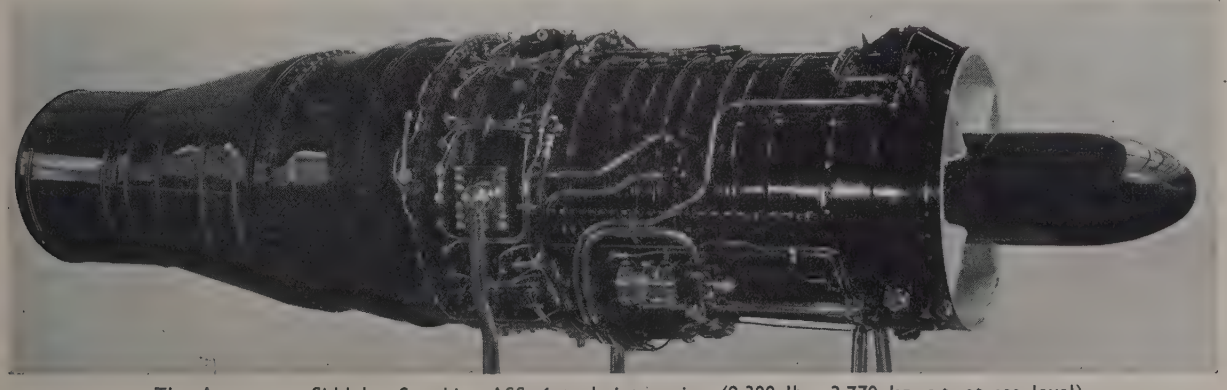
COMBUSTION CHAMBER.—Single annular type with inner and outer flame tubes between which combustion takes place. Outer tube of Fox Fortiweld ; inner tube of DTD493. Thirty-six Armstrong Siddeley type fuel-air vaporisers. Fuel and primary air fed into hook-shape vaporiser tubes whose open ends point upstream. Secondary air enters chamber through 36 air distributing tubes to mix with combustion flame near vaporiser tubes. B.T.H. high energy ignition unit type C.10/TS/2. Two Lodge high energy igniter plugs in diametrically-opposite positions.

FUEL SYSTEM.—Armstrong Siddeley vaporising type. Pressure of 480 lb./sq. in. (33.75 kg./cm.^{2}) at burners supplied by Dowty Type ENG.129 fuel pump. Armstrong Siddeley-Hobson barometric flow control and distributors (six). Lucas air-fuel ratio control.

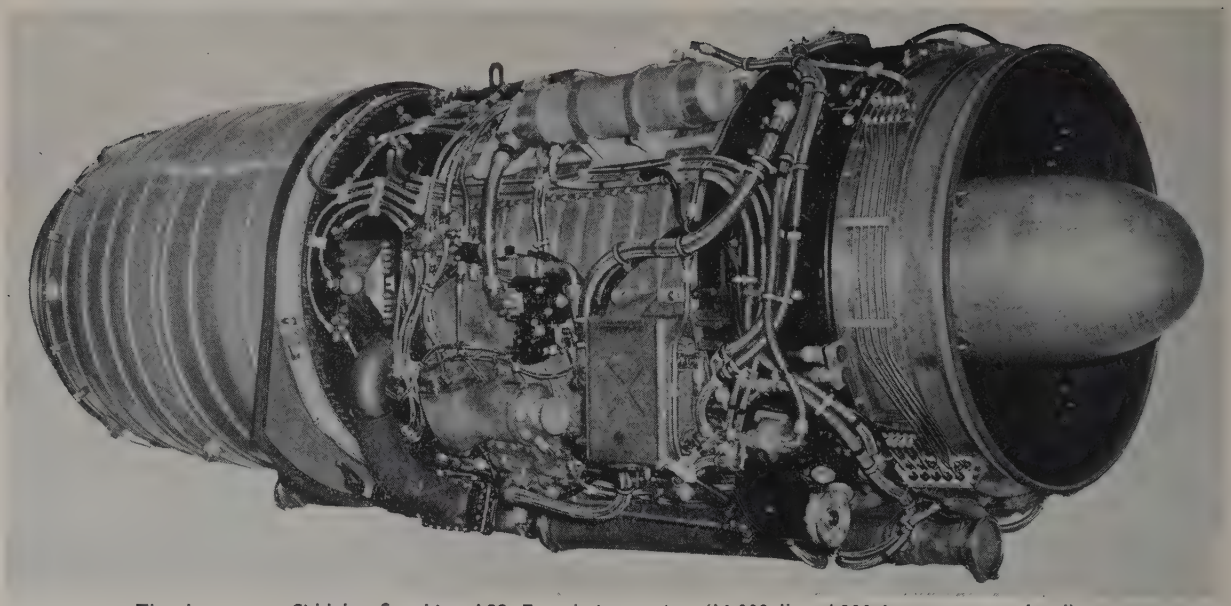
FUEL GRADE.—DERD.2482 or 2486. As emergency alternative 100 BO AVGAS.

NOZZLE GUIDE VANES.—Aerofoil type, cast in Nimonic 80.

TURBINE.—Two-stage turbine, each disc forged in ferritic steel (Rex 448 or Jessops H.46), coupled together by dowels. Front disc in turn dowelled to turbine stubshaft. First stage has N.90 blades, second stage N.80A blades, all secured by "fir-tree" roots and locked by special split pins. Surrounding the turbine assembly is a series of ring assemblies, carrying the N.80 stator blades. Front end of turbine rotor shaft bolted to compressor rotor shaft



The Armstrong Siddeley Sapphire ASSa.6 turbojet engine (8,300 lb.=3,770 kg. s.t. at sea level).



The Armstrong Siddeley Sapphire ASSa.7 turbojet engine (11,000 lb.=4,990 kg. s.t. at sea level).

drive coupling. Single-row roller bearing forward of rotor disc assembly.

JET PIPE.—Fixed type (either fixed or two-position nozzle when 25% boost afterburner fitted). Steel jet pipe with light alloy outer shrouds, separated by Alfol lagging. Fully floating central bullet.

ACCESSORY DRIVE.—Off front of compressor, via shaft and bevel through air intake spokes. Accessories on "kidney box" below compressor.

LUBRICATION SYSTEM.—Full flood to front bearing. Micro-feed with air blast cooling to centre and rear bearings. Capacity 9½ Imp. pints (5.4 litres). Supplied at pressure of 30 lb./sq. in. (2.11 kg./cm.²) by Tecalemit pump.

OIL SPECIFICATION.—D.Eng. R.D. 2487.

MOUNTING.—Three point trunnion suspension, with one point on top of intake flange and others on each side of centre section.

STARTING.—Rotax type CT.0201-L cartridge turbo-starter bolted to front of intake hub.

DIMENSIONS.—
Diameter, excluding accessories 37.4 in. (950 mm.).
Length overall 134 in. (3,400 mm.).

WEIGHT.—
Dry 2,670 lb. (1,210 kg.).

PERFORMANCE RATING.—
Static thrust 8,300 lb. (3,770 kg.) at 8,600 r.p.m. at sea level.
Max. continuous 7,070 lb. (3,207 kg.) s.t. at 8,200 r.p.m.

CONSUMPTION.—
Fuel 0.85 lb./lb. s.t./hr. (0.85 kg./kg. s.t./hr.).
Oil 1½ Imp. pints (0.85 litres) hr.

THE ARMSTRONG SIDDELEY SAPPHIRE SERIES 200.

The Series 200 Sapphire was developed from the Series 100 to provide an engine suitable for very high subsonic and supersonic speeds, with a much greater thrust than the ASSa.6, but with a minimum of installational changes. The following versions have been announced :—

ASSa.4. Basically similar configuration to ASSa.6. First run in July, 1952. Rated at 9,700 lb. (4,400 kg.) s.t.

ASSa.4/7. Modified version of ASSa.4 with change from aluminium to steel compressor casing.

ASSa.7. Further development of ASSa.4 with flared annulus, achieved by change in turbine root and tip diameters. Reverted to aluminium compressor casing. In September, 1954, was type-tested at 10,200 lb. (4,650 kg.) thrust with a specific fuel consumption of 0.885 lb./hr./lb. (0.885 kg/hr./kg.), thus becoming the first British turbojet engine to be type-tested at over 10,000 lb. (4,540 kg.) s.t. Passed further type test at 10,500 lb. (4,765 kg.) s.t. in March, 1955. Following later changes, including introduction of unshrouded turbine rotor blades, production engines have been rated since March, 1956 at 11,000 lb. (4,990 kg.) s.t.

ASSa.7R. Similar to ASSa.7, but with afterburner giving a 12% increase in thrust at heights above 20,000 ft. (6,100 m.). Used in Gloster Javelin F. (A.W.) Mk. 8.

ASSa.8. Development of ASSa.7 with air-cooled turbine blading. Rated at 12,360 lb. (5,606 kg.) s.t. No production.

ASSa.9. Further development of ASSa.7 with zero-stage in compressor and variable-incidence guide vanes. Rated at 12,700 lb. (5,760 kg.) s.t. No production.

The following details apply specifically to the Sapphire ASSa.7 :—

TYPE.—Axial-flow turbojet.

AIR INTAKE.—Annular type at front of engine. Hot air from compressor exit ducted through intake struts, inlet guide vanes and nose fairing.

COMPRESSOR.—Thirteen-stage axial-flow. Rotor blades machined from stampings in S.62 steel and attached to a series of discs which are curvic coupled to steel shaft. First six rows have serrated root fixings; last seven rows are riveted to discs. Total of 584 stator blades, made in S.62 steel and with dovetail roots fitting into loose rings. Shaft carried in front thrust and rear roller bearing. Casing made from L.51 aluminium alloy to R.R.50 specification with magnesium-zirconium Z.T.1 as alternative.

COMBUSTION CHAMBER.—Similar to series 100 Sapphire, but with more definite form of splitter-diffusion section and only 24 fuel vaporiser tubes.

FUEL SYSTEM.—Armstrong Siddeley vaporising type. Dowty ENG. 191 Mk. 5 fuel pump. Armstrong Siddeley-Hobson flow control and distributors. Lucas Air/Fuel ratio control. Ultra two-datum jet pipe temperature control.

FUEL GRADE.—DERD. 2482 or 2486.

NOZZLE GUIDE VANES.—Cast in Nimonic 80A or Jessops G.39.

TURBINE.—Two-stage axial turbine, each disc forged in Firth Vickers Rex 448 ferritic steel and splined to shaft. First stage has N.90 blades, second stage N.80A blades, all secured by fir-tree roots. Discs splined to shaft.

JET PIPE.—Normally fixed. Variable nozzle when 12% partial afterburner fitted.

ACCESSORY DRIVE.—Drives available axially and tangentially from air casings. Accessories mounted on aircraft gearbox.

LUBRICATION SYSTEM.—Flood feed type with Armstrong Siddeley and Plessey pumps and accessories. Capacity 18 Imp. pints (10.23 litres). Minimum oil pressure, at 24% r.p.m. and above, 30 lb./sq. in. (2.11 kg./cm.²). Maximum oil pressure, at 35% r.p.m., 12 lb./sq. in. (0.84 kg./cm.²).

OIL SPECIFICATION.—DERD. 2487.

MOUNTING.—Same as for Series 100 Sapphire.

STARTING.—Rotax type C.6805 electric starter in nose fairing.

DIMENSIONS.—
Diameter 37.35 in. (948 mm.).
Length overall 130.7 in. (3,320 mm.).
Length overall with reheat jet-pipe 293 in. (7,440 mm.).
Frontal area 6.13 sq. ft. (0.57 m.²).

WEIGHTS.—
Dry 3,030 lb. (1,375 kg.).
Dry, with reheat jet-pipe 3,180 lb. (1,442 kg.).
Complete with accessories 3,218.75 lb. (1,460 kg.).

PERFORMANCE RATING.—
Static thrust 11,000 lb. (4,990 kg.) at 8,600 r.p.m. at sea level.
Max. continuous 9,600 lb. (4,355 kg.) s.t. at 8,200 r.p.m.
With 12% reheat 12,300 lb. (5,580 kg.) s.t.

CONSUMPTIONS.—
Fuel at take-off rating 0.885 lb./lb. s.t./hr. (0.885 kg./kg. s.t./hr.).
Fuel, with reheat 1.20 lb./lb. s.t./hr. (1.20 kg./kg. s.t./hr.).
Oil 1 Imp. pint/hr. (0.57 litres/hr.).

THE ARMSTRONG SIDDELEY P.181 AND P.182.

These two engines are being developed simultaneously, the P.181 being intended for rotating-wing aircraft and the P.182 for fixed-wing aircraft. They are basically the same and make use of the same compressor, combustion chamber and turbine assemblies. The principal differences are in the reduction gearing and final drives.

Both engines have a three-stage compressor, comprising two axial stages and one centrifugal stage. This is driven by a two-stage turbine, with a free power turbine driving the output shaft through reduction gearing.

In the case of the P.181, a power take-off can be provided either from the front or the rear of the engine.

The following details are common to both the P.181 and P.182 :—

COMPRESSOR.—Two-stage subsonic axial-flow compressor, followed by a single-stage centrifugal compressor. Overall compression ratio 5.91 : 1. Maximum compressor speed 20,000 r.p.m. Air mass flow 12.5 lb./sec. (5.67 kg./sec.).

COMBUSTION CHAMBER.—Annular reverse-flow type. Armstrong Siddeley vapourising type burners.

FUEL SYSTEM.—Armstrong Siddeley design.

TURBINE.—Two-stage axial-flow type driving compressor, plus single-stage free turbine driving rotor or airscrew through reduction gearing.

ACCESSORY DRIVES.—Engine accessories driven through integral gearbox at bottom of compressor casing. In P.182 a second accessory drive from airscrew reduction gearing is available for aircraft accessories which have to be tied to airscrew r.p.m.

LUBRICATION SYSTEM.—Self-contained flood-feed fully-scavenging type. Oil tank cast integral with upper half of compressor

stator casing. Pressure and scavenge oil pumps fitted within accessory drive box, beneath compressor stator casing.
STARTING.—Electric or iso-propyl-nitrate starter.
ANTI-ICING.—Thermal and electric (P.182), thermal (P.181).
DIMENSIONS (P.181).—
Overall length with exhaust cone 48.53 in. (1,233 mm.).
Diameter 27.4 in. (696 mm.).
DIMENSIONS (P.182).—
Overall length with exhaust cone 59.97 in. (1,523 mm.).
Diameter 27.3 in. (694 mm.).
WEIGHT (P.181).—
Dry approx. 540 lb. (245 kg.).
WEIGHT (P.182).—
Dry approx. 600 lb. (272 kg.).
PERFORMANCE RATING (P.181).—
Max. rating at S/L 1,020 s.h.p.+200 lb. (91 kg.) s.t. at 20,000 compressor r.p.m., 14,600 power turbine r.p.m.
PERFORMANCE RATING (P.182).—
Max. rating at S/L 1,100 s.h.p.+200 lb. (91 kg.) s.t. at 20,000 compressor and power turbine r.p.m., 1,448 airscrew r.p.m.
CONSUMPTION (P.181).—
Max. rating 0.71 lb./s.h.p./hr. (0.32 kg./s.h.p./hr.).
CONSUMPTION (P.182).—
Max. rating 0.65 lb./e.s.h.p./hr. (0.29 kg./s.h.p./hr.).

THE ARMSTRONG SIDDELEY MAMBA.

The Mamba is a turboprop engine of the straight-through flow type, of which several versions are in existence, as follows :—

ASM.1. Initial version, type-tested at a maximum power of 980 s.h.p. in February, 1948.

ASM.2. Rated at 850 s.h.p. Not built.

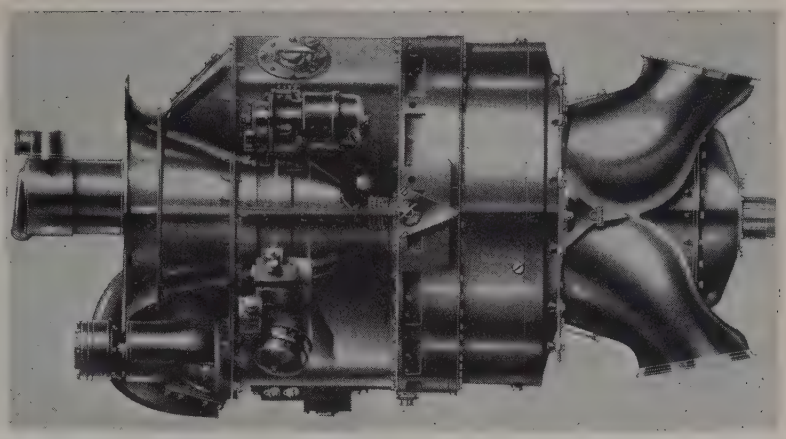
ASM.3. Type-tested in 1951 at power of 1,475 e.h.p. (1,310 s.h.p. plus 405 lb.= 184 kg. s.t.).

ASM.5. Rated at 1,590 e.h.p. (1,480 s.h.p. plus 295 lb.=134 kg. s.t.).

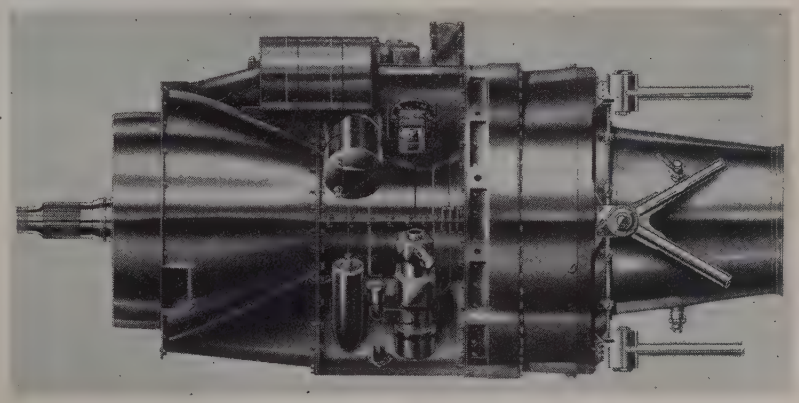
ASM.6 (Mark 110). Introduced zero-stage in compressor and third turbine stage. This version is described below.

ASM.7. Designed as civil engine. Not built.

ASM.8 (Mk. 505). Uprated version of ASM.6, with Nimonic 100 turbine blades, type-tested in 1957. Awarded special category approval for civil use in 1958. Take-off rating of 2,075 e.h.p. with specific fuel consumption of 0.665 lb./e.h.p./hr. (0.301 kg./e.h.p./hr.). Cruise rating of 1,825 e.h.p. with specific consumption of 0.68 lb./e.h.p./hr. (0.308 kg./e.h.p./hr.). Weight 975 lb. (442 kg.). Flight tested in Dakota aircraft in 1958.



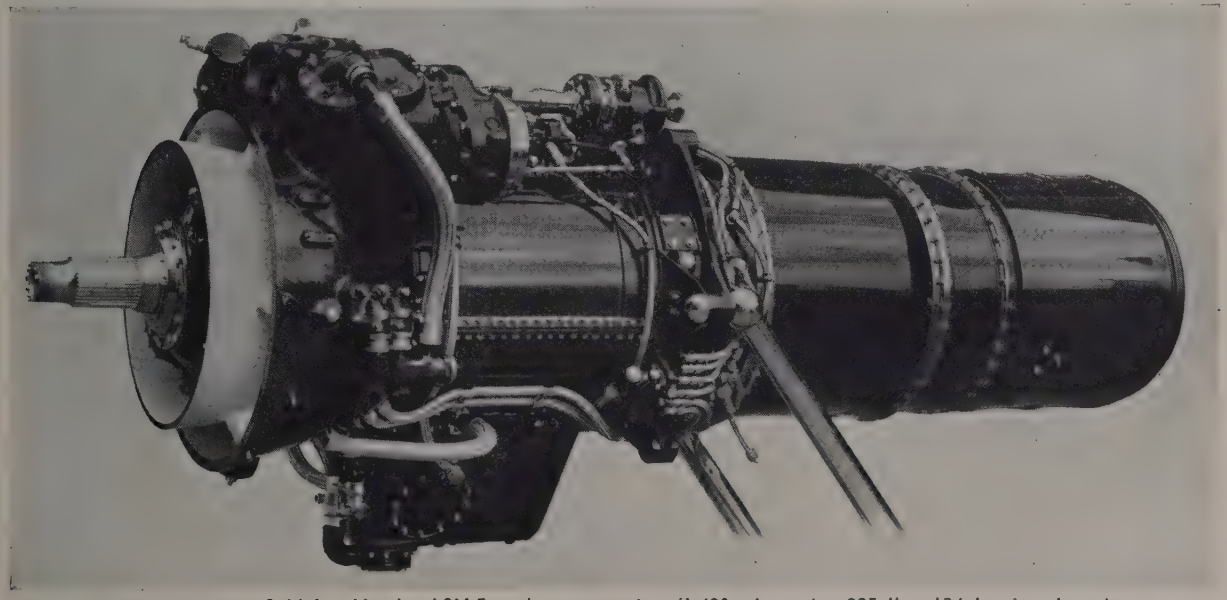
The Armstrong Siddeley P.181 shaft turbine for helicopter use.



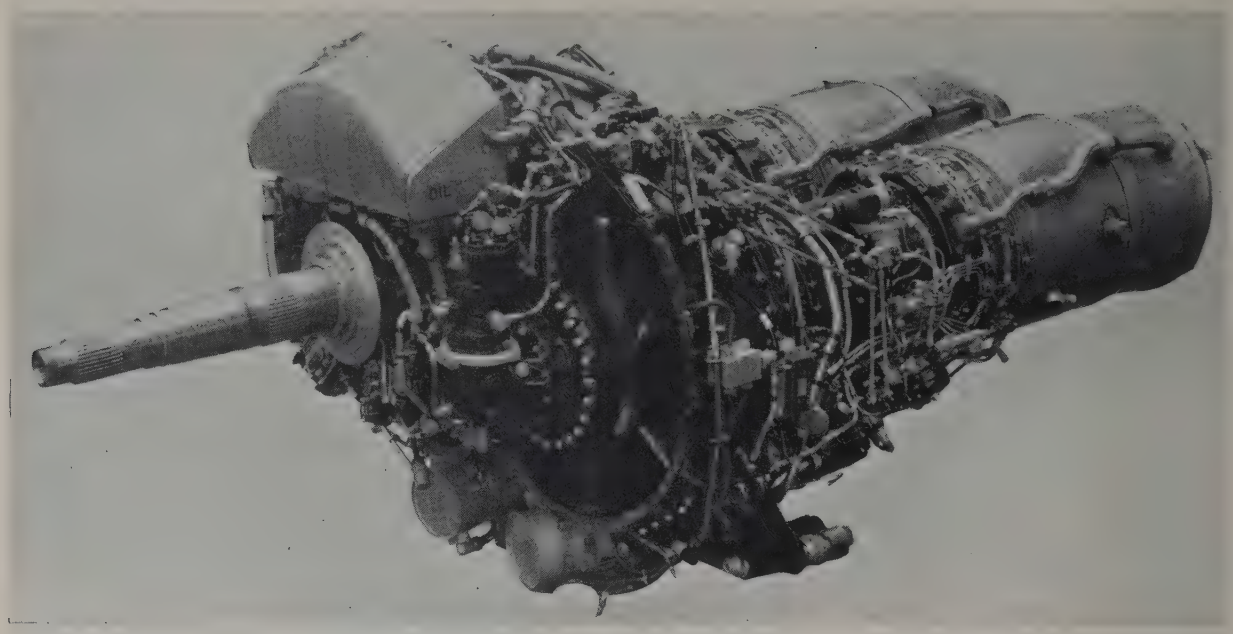
The Armstrong Siddeley P.182 turboprop engine.

The following details refer specifically to the ASM.6 Mamba :—

TYPE.—Axial-flow Turboprop.
AIRSCREW DRIVE.—Shaft drive from compressor through compound epicyclic helical and spur reduction gearing. Standard gear ratio 0.1138 : 1. Shaft supported by one ball thrust bearing and one roller bearing.
AIR INTAKE.—Annular intake surrounding reduction-gear. Electrically-heated intake guide vanes and rubber heating mats in intake for de-icing.
COMPRESSOR.—Eleven-stage axial-flow type, made up of a series of discs on a small diameter drum. First four and last three rows have steel rotor blades ; rows 5-8 have aluminium blades. First four rows have fir-tree root fixings ; remainder are riveted to discs. Front and rear shafts supported in ball and roller bearings respectively. Two-piece forged aluminium-alloy casing, split horizontally, with one row of entry guide vanes, eleven rows of light-alloy stator blades and one row of outlet straightener blades dovetailed into rings.
COMBUSTION CHAMBER.—Annular type.
FUEL SYSTEM.—Armstrong Siddeley constant-speed control system. Dowty fuel pump. Armstrong Siddeley-Hobson flow control and anticipator. Rotol P.C.U. Ultra jet pipe temperature control.
FUEL GRADE.—DERD.2482, 2486 or 2488.
TURBINE.—Three-stage axial-flow type.
TAIL PIPE.—Fixed area type of stainless steel.
ACCESSORY DRIVE.—Rearward from reduction gear casing to aircraft accessory gearbox.



The Armstrong Siddeley Mamba ASM.5 turboprop engine (1,480 s.h.p. plus 295 lb.=134 kg. jet thrust).



The Armstrong Siddeley Double Mamba ASMD.8 turboprop engine (3,600 s.h.p. plus 710 lb.=322 kg. jet thrust).

LUBRICATION.—Fully-scavenged type, with Armstrong Siddeley pumps. Capacity 32 Imp. pints (18.18 litres). Normal oil supply pressure: minimum 35 lb./sq. in. (2.46 kg./cm.²), maximum 70 lb./sq. in. (4.92 kg./cm.²).
OIL.—DERD.2487.
MOUNTING.—Six mounting bosses incorporated in centre section.
STARTING.—Rotax cartridge turbo-motor on port side of reduction gear. Provision for operating this starter on compressed air.
DIMENSIONS (ASM.6).—
Diameter 33.9 in. (861 mm.).
Length from airscrew cone fitting line to exhaust cone rear flange 61.4 in. (1,560 mm.).
WEIGHT (ASM.6).—
Dry 1,003 lb. (455 kg.).
RATING (ASM.6).—
Take-off (static) 1,650 shaft h.p. plus 320 lb. (145 kg.) jet thrust (1,770 equivalent s.h.p.) at 15,000 r.p.m. at sea level.
CONSUMPTIONS (ASM.6).—
Fuel, at take-off rating 154 Imp. gallons/hr. (700 litres/hr.).
Oil, 0.5 Imp. pint/hr. (0.28 litre/hr.).

THE ARMSTRONG SIDDELEY DOUBLE MAMBA.

The Double Mamba, which powers the Fairey Gannet anti-submarine aircraft, consists basically of two Mamba engines placed side-by-side and driving two contra-rotating co-axial airscrews. Although the two engines are joined together at the front end and use the same air intake and airscrew-shaft gear casing, they are otherwise two quite separate power-units. Each has its own fuel, lubrication and control systems, its own reduction-gear and each drives one of the two co-axial airscrews. Each engine can be stopped, started, cruised or feathered under conditions entirely separate from the other.

The following versions have been announced :—

ASMD.1. Made up of two ASM.3 units. Rated at 2,850 e.s.h.p. (2,540 s.h.p. plus 925 lb.=420 kg. s.t.).

ASMD.3. Made up of two ASM.5 units. Rated at 3,145 e.s.h.p. (2,800 s.h.p. plus 900 lb.=408 kg. s.t.).

ASMD.4. Made up of two ASM.6 units. Completely new forward end, with lower thrust line and double-helical reduction gearing. Development only. Rated output 3,300 s.h.p. plus 640 lb. (290 kg.) s.t.

ASMD.8. Made up of two ASM.8 units. Lower thrust line than ASMD.1 and 3. Rated output 3,875 e.h.p. (3,600 s.h.p. plus 710 lb.=322 kg. s.t.). In production.

The two engines in each version are standard Mambas and the description which follows is only concerned with the components which are peculiar to the Double Mamba ASMD.8 version.

TYPE.—Dual Turboprop made up of two Mamba engines, each driving independently one of two co-axial airscrew shafts.
COMPRESSORS, COMBUSTION CHAMBERS, TURBINES.—As for Mamba.
FRONT CASING.—Two Mamba engines without their individual reduction gears mounted on front casing which houses epicyclic and simple gear trains in coupling gears, and drives for engine auxiliaries and aircraft accessory gear box. Each airscrew shaft has its separate train of gears and a roller clutch to prevent rotation during flight when either airscrew is feathered. A free-wheel arrangement enables either unit to drive the aircraft accessories drive-shaft. Casing consists of three main magnesium-zirconium castings containing the reduction gearing and air passages from kidney-shaped air entries to an annulus before the compressors. Electrically-heated inlet guide vanes and rubber heater mats for de-icing. Inlet air flow 42 lb./sec. (19.05 kg./sec.).
AIRSCREW DRIVE.—Two co-axial independent airscrew shafts, sizes S.B.A.C. No. 5 (front) and No. 7 (rear). Planetary and spur type reduction gear, ratio 0.0874 : 1 (11.43 : 1), driven from compressors. Torque-meters and airscrew brakes are incorporated. Shafts, whose centre-lines are 6 in. (15.24 cm.) above those of the two engine units, supported by ball and roller bearings. Provision for two Rotol four-blade constant-speed feathering and braking contra-rotating airscrews.
FUEL SYSTEM.—Each engine component has its individual system as for Mamba.
FUEL GRADE.—DERD.2482, 2486 or 2488.
ACCESSORY DRIVES.—Rotol gearbox mounted above air intake casing and driven by shaft which is geared to both airscrew shafts, an idler being inserted to obtain correct direction of rotation. Free-wheel assembly provided to avoid connected drive between two components. Drive can transmit up to 200 h.p. at maximum r.p.m. and full power is available when either engine is feathered.
LUBRICATION.—Separate system for each half as for Mamba ASM.8. Each gear train in reduction gear is lubricated with oil from driving engine.
OIL.—DERD.2479/1.
MOUNTING.—Three-point suspension. One point above reduction gear and two below gear.
DIMENSIONS (ASMD.8).—
Width 56.55 in. (1,435 mm.).
Height 51.15 in. (1,299 mm.).
Length from airscrew cone abutment face to exhaust cone rear flange 98.62 in. (2,505 mm.).
WEIGHTS (ASMD.8.—Mk. 102).—
Dry 2,450 lb. (1,111 kg.).
Complete with accessories 2,584 lb. (1,172 kg.).
RATINGS (ASMD.8.).—
Take-off (static) 3,600 shaft h.p. + 710 lb. (322 kg.) jet thrust at 15,000 r.p.m.
CONSUMPTIONS (ASMD.8).—
Fuel at take-off rating 320 Imp. gallons/hr. (1,551 litres/hr.).

THE ARMSTRONG SIDDELEY VIPER.

The Viper turbojet was originally designed for "short-life" full-throttle operation in expendable aircraft such as the Australian Jindivik pilotless target aircraft, for which the Viper ASV.3 was produced.

In order to reduce cost this version was simplified as far as practicable and, consistent with its short but active life, only the most economical low grade materials were used in its construction.

The number of accessories was reduced to two assemblies for the ASV.3, a combined fuel and oil pump assembly and a fuel flow control.

As a result of the success and overall efficiency of the "short-life" Viper, a "long-life" version was developed for use in the Hunting Percival Jet Provost and other piloted aircraft. This engine retains much of the desirable simplicity of the "short-life" engine, but has been modified in various respects in order to give an overhaul life equal to that of any other conventional aero-engine.

The following versions of the Viper have been announced :—

ASV.1. Initial "short-life" design study. Rated at 1,145 lb. (520 kg.) s.t. Not built.

ASV.2. Developed "short-life" version. First run in April, 1951. Type-tested at 1,500 lb. (680 kg.) s.t.

ASV.3 (Mark 100). Production "short-life" version for Jindivik pilotless target aircraft, as Viper Mk. 100. First flight-tested in tail of Lancaster test-bed in November, 1952. Type-tested at 1,640 lb. (745 kg.) s.t. Production completed.

ASV.4. "Short-life" development of ASV.3, rated at 1,750 lb. (795 kg.) s.t. First run in 1952.

ASV.5 (Mark 101). Production "long-life" version for Hunting Percival Jet Provost T. Mk. 1 and Folland Midge. Type-tested at 1,640 lb. (745 kg.) s.t. First run in November, 1953. Produced as Viper Mk. 101.

ASV.6. "Short-life" version, rated at 1,900 lb. (860 kg.) s.t. First run in 1952.

ASV.7R. "Long-life" turbojet, with reheat, rated at 2,470 lb. (1,120 kg.) s.t.

ASV.8 (Mk. 102). "Long-life" version, type-tested at 1,750 lb. (795 kg.) s.t. Powers Hunting Percival Jet Provost T. Mk. 3 as Viper Mk. 102.

ASV.9 (Mk. 103). "Long-life" version similar to ASV.8 except for turbine materials. Rated at 1,900 lb. (862 kg.) s.t. Produced as Viper Mk. 103.

ASV.10. "Long-life" version. Redesigned compressor, similar to that of the latest Sapphires, with the blades mounted on discs carried on a central drum and a Sapphire-type combustion chamber backplate with 24 burners. Its mass flow is increased to 42 lb. (19.05 kg.) per sec. at 13,400 r.p.m. Compression ratio is 3.91 : 1. Rated at 2,000 lb. (907 kg.) s.t. First ran in January, 1956.

ASV.11. "Long-life" version, similar to ASV.10 but rating increased to 2,450 lb. (1,111 kg.) s.t. by increased mass flow and running at higher peak temperatures.

A licence for the production of the Viper in France has been acquired by the Dassault company by whom it is called the M.D.30 Viper. This company has developed its own afterburner unit and the version fitted with this is known as the M.D.30R.

The Dassault Company have developed a further version of the Viper, known as the R.7 Farandole. This is a straightforward scaled-up version of the ASV.10 and will have a Dassault afterburner capable of augmenting the thrust by 30% and Bendix fuel system.

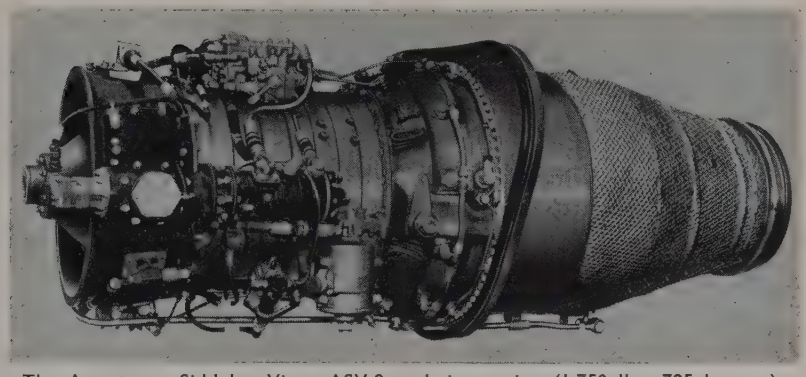
The following details apply to the Viper ASV.8 and 9, but are generally applicable to other "long-life" versions :—

TYPE.—Axial-flow Turbojet.

AIR INTAKE.—Annular type at front of engine. Anti-icing by electrically-heated intake guide vanes and air intake heater mats.

COMPRESSOR.—Seven-stage axial-flow, of disc-type construction. Discs of aluminium alloy bolted to front and rear stubshafts. Total of 400 stator blades made from R.R.57 aluminium alloy. Total of 453 rotor blades, the first row made of S.62 stainless steel and the remainder of R.R.57 aluminium alloy. Stator blades dovetailed direct into grooves in casing with resin fixative. Rotor blades tongued and grooved between adjacent discs. Compressor shaft carried in front ball combined thrust and journal bearing and rear parallel roller bearing. Compressor casing cast in top and bottom halves in L.51 aluminium alloy, bolted together. Compression ratio 4.1 : 1. Air mass flow 32 lb./sec. (14.5 kg./sec.).

COMBUSTION CHAMBER.—Single annular type with outer casings of chromium nickel non-corrosive steel and inner flame tubes of chromium-nickel heat-resisting steel, between which combustion takes place. Fuel and primary air fed into 12 pairs of hook-shape Armstrong Siddeley vaporiser tubes whose open ends point upstream. B.T.H. high energy ignition system with two diametrically-opposed Lodge igniter plugs.



The Armstrong Siddeley Viper ASV.8 turbojet engine (1,750 lb.=795 kg. s.t.).

FUEL SYSTEM.—Low-pressure vaporising type. Pressure of 616 lb./sq. in. (43.3 kg./cm.²) at burners supplied by Lucas G.B.B. pump. Armstrong Siddeley-Hobson flow control and Lucas air-fuel ratio control.

FUEL GRADE.—DERD.2482 or 2486.

NOZZLE GUIDE VANES.—Single row of 93 blades, made from G.39 steel, retained in inner and outer sheet metal rings.

TURBINE.—Single-stage axial-flow turbine. Disc of Rex 448 or H.46 steel, with peripheral "fir-tree" slots to retain the 113 blades, which are made from Nimonic 90. Turbine disc is located on mainshaft by a bolt and Hirth-type coupling. Single-row roller bearing ahead of disc. Gas temperature before turbine 840°C., after turbine 707°C.

JET PIPE.—Fixed type. Chromium nickel non-corrosive steel cone.

ACCESSORY DRIVE.—Axial drive at front of engine, or via bevel gearing from front of compressor shaft, via intake spoke. Accessories mounted on aircraft gearbox.

LUBRICATION SYSTEM.—Flood feed to front bearing and gearcase. Micro-pump total loss feed to centre and rear bearings. Tecalemit plunger pumps. Oil capacity 14 pints (7.95 litres). Normal oil supply pressure 30 lb./sq. in. (2.11 kg./cm.²).

OIL SPECIFICATION.—DERD.2487.

MOUNTING.—Two trunnions at mid-length of engine, with steady point on air intake flange.

STARTING.—Rotax electric starter or L.P. air starting by impingement on turbine blades.

DIMENSIONS (ASV.8 and 9).—
Diameter 24.03 in. (610 mm.).
Length 82.5 in. (2,095 mm.).
Frontal area 261.6 sq. in. (1,688 cm.²).

WEIGHTS.—
ASV.5, complete with accessories 515 lb. (234 kg.).
ASV.8 and 9, dry 530 lb. (240 kg.).
ASV.10, complete with accessories 570 lb. (259 kg.).

PERFORMANCE RATINGS.—
ASV.5 take-off (static) 1,640 lb. (745 kg.) at 13,400 r.p.m.
ASV.8 take-off (static) 1,750 lb. (795 kg.) at 13,800 r.p.m.
ASV.8 max. continuous 1,475 lb. (670 kg.) at 13,100 r.p.m.
ASV.9 take-off (static) 1,900 lb. (862 kg.) at 13,400 r.p.m.
ASV.10 take-off (static) 2,000 lb. (907 kg.) at 13,400 r.p.m.
ASV.10 max. continuous 1,630 lb. (740 kg.) at 12,700 r.p.m.
ASV.11 take-off (static) 2,450 lb. (1,111 kg.) at 13,400 r.p.m.
ASV.11 max. continuous 2,020 lb. (916 kg.) at 12,700 r.p.m.

CONSUMPTIONS.—
ASV.5 fuel 1.09 lb./lb. s.t./hr. (1.09 kg./kg. s.t./hr.).
ASV.8 and 9 fuel 1.12 lb./lb. s.t./hr. (1.12 kg./kg. s.t./hr.).
ASV.10 fuel 1.01 lb./lb. s.t./hr. (1.01 kg./kg. s.t./hr.).
ASV.11 fuel 1.11 lb./lb.. s.t./hr. (1.11 kg./kg. s.t./hr.).
ASV.8 and 9 oil 1 pint/hr. (0.57 litres/hr.).

THE ARMSTRONG SIDDELEY PR.23.

Exhibited for the first time at the 1958 S.B.A.C. Display, the PR.23 is a very small liquid-propellent rocket engine giving 500 lb. (225 kg.) s.t. It is intended mainly as a trimmer motor for large ballistic rockets, but could be used also as a trim device for manned aircraft at high altitudes.

THE ARMSTRONG SIDDELEY "BLACK KNIGHT" ENGINE.

Armstrong Siddeley manufacture the liquid-propellent rocket engine used in the Saunders-Roe Black Knight re-entry test missile. Few details are available except that it has four exhaust nozzles, which are individually gimbal-mounted to provide three-axis control of the missile, and employs H.T.P. and kerosene propellents. It probably gives about 20,000 lb. (9,075 kg.) s.t.

BLACKBURN-TURBOMECA

BLACKBURN & GENERAL AIRCRAFT, LTD.

HEAD OFFICE AND WORKS, ENGINE DIVISION : BROUGH, E. YORKS.

LONDON OFFICE : 43, BERKELEY SQUARE, W.1.

Directors : E. Turner, A.C.A. (Chairman and Managing Director); Major F. A. Bumpus, B.Sc., A.R.C.S., Wh.Sc., F.R.Ae.S. ; N. E. Rowe, C.B.E., B.Sc., M.I.Mech.E., Whit.Ex., F.R.Ae.S. ; Marshal of the Royal Air Force Sir John Slessor, G.C.B., D.S.O., M.C. ; Air Vice-Marshal H. N. Thornton, C.B.E. ; T. Bancroft ; A. F. Jopling and Capt. E. D. G. Lewin, C.B., C.B.E., D.S.O., D.S.C., R.N. (Retd.).

General Manager : J. B. Bucher, Dip. Ing., M.I.Mech.E., M.I.E.S., M.I.S.I.

Secretary : R. H. Stone, A.C.A.

Sales Manager : Group Capt. H. J. Wilson, C.B.E., A.F.C.

Blackburn & General Aircraft, Ltd. hold the exclusive manufacturing and selling rights in the United Kingdom and most of the British Commonwealth for the French-designed Turbomeca gas-turbine engines.

Blackburn has redesigned the first group of engines on which it is at present concentrating, various modifications having been embodied in order to meet British requirements and to simplify production. The Blackburn Turbomeca engines are known as the 500 and 600 Series, the 500 Series engines having their mass flow reduced to approximately two-thirds of that of the 600 Series.

The 500/600 Series engines, which have a maximum number of interchangeable parts, can be divided into three main categories, namely pure jet engines (Palas), shaft turbines (Artouste and Turmo) and air compressors (Palouste). The Palas, which is the basic engine in the range, is suitable for installation in small pure jet aircraft, such as trainers and target aircraft. The other units have a variety of uses, the most obvious being as helicopter power-units.

In addition to this work, Blackburn is developing a new free-turbine shaft-turbine under the designation of A129.

Full details of the French Turbomeca range of gas-turbine engines will be found under "Turbomeca" (France).

THE BLACKBURN-TURBOMECA PALAS 600.

TYPE.—Small centrifugal-flow turbojet.

AIR INTAKE.—Aluminium-alloy casting integral with compressor casing. Incorporates twin air intakes on each side of front bearing and nose shaft housing. Two oil tanks integral with casing on each side of air intake ducts.

COMPRESSOR.—Single-sided centrifugal type. Steel rotating guide vanes and an aluminium-alloy impeller are shrunk on front end of hollow mainshaft which rotates in high-speed ball thrust bearing.

COMBUSTION CHAMBER.—Annular type inside sheet steel casing. Combustion chamber and nozzles fabricated in Nimonic 75.

FUEL SYSTEM.—Fuel is passed from front of engine, through mainshaft, and is injected centrifugally through radial holes in shaft into flame zone of combustion chamber. System incorporates a Plessey gear-type pump with Lucas fuel control unit. A single lever, in conjunction with a centrifugal governor, controls fuel supply for operating conditions above idling speed. Blackburn torch igniter at top of compressor casing for initial light-up. Fuel from main supply, controlled by a valve, is ignited for starting by H.T. current from an ignition unit.

TURBINE.—Single-stage axial-flow type. Disc, machined from Nimonic 90, is bolted to rear of mainshaft jointly with rear bearing stub shaft which is supported in high-speed roller bearing. Blades machined on stub shaft induce air through tubes traversing annulus of exhaust diffuser to cool rear bearing.

JET-PIPE.—Fixed-area type.

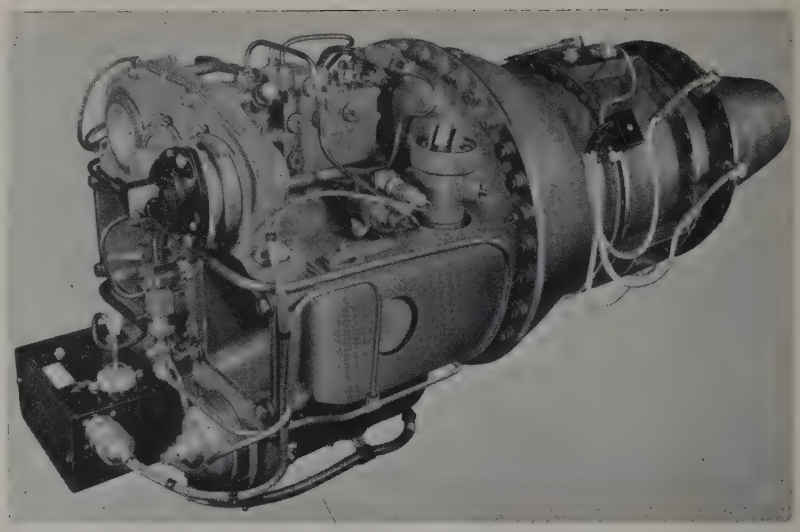
ACCESSORIES.—Accessories gear boxes mounted above and below front casing. Each has three forward and three rearward mounting faces, and encloses a system of spur gears driven from rotor shaft.

LUBRICATION SYSTEM.—Compound gear pump comprising one pressure pump supplying front and rear bearings and two scavenge pumps, each returning oil from one bearing.

DIMENSIONS.—
Overall length 30.07 in. (764 mm.).
Max. diameter 17.50 in. (445 mm.).

WEIGHT.—
Dry 169 lb. (76.65 kg.).

PERFORMANCE RATINGS.—
Take-off rating 390 lb. (177 kg.) s.t.
Max. continuous 328 lb. (149 kg.) s.t.



The Blackburn-Turbomeca Palas 600 turbojet engine (390 lb.=177 kg. s.t.).

CONSUMPTIONS.—
Fuel at take-off rating 465 lb./hr. (211 kg./hr.).
Fuel at max. continuous rating 380 lb./hr. (172 kg./hr.).

THE BLACKBURN A 129.

The Blackburn A 129 is a free-turbine shaft-turbine, the development of which is being undertaken by the company as a private venture. It makes use of many well-proven components of existing Blackburn engines, and is basically an Artouste 600 with two axial-flow compressor stages added forward of the centrifugal compressor. The shaft-drive is taken via a free-turbine and a Turmo-type gearbox.

First run as turbojet in July, 1958, and as shaft-turbine in August, 1958, with initial rating of 840 s.h.p. After turbine modifications it will give 950 s.h.p.

TYPE.—Free-turbine Shaft-turbine.

AIR INTAKE.—Annular aluminium alloy casting with three radial struts supporting front ball thrust bearing.

COMPRESSOR.—Two-stage axial-flow compressor, followed by single centrifugal stage. Compression ratio 6.35 : 1. Air mass flow 11 lb./sec. (5.0 kg./sec.).

COMBUSTION CHAMBER.—Annular type.

FUEL SYSTEM.—Gear-type pump supplies fuel metered by a mechanically-governed control unit. Fuel is injected centrifugally into flame zone of combustion chamber through radial holes in hollow mainshaft. Starting is by torch igniter.

COMPRESSOR TURBINE.—Two-stage axial-flow type.

POWER TURBINE.—Single-stage free turbine.

REDUCTION GEAR.—Helical spur type.

JET-PIPE.—Bifurcated type.

ACCESSORIES.—Engine-driven auxiliaries and accessories mounted on taper flanges around air intake.

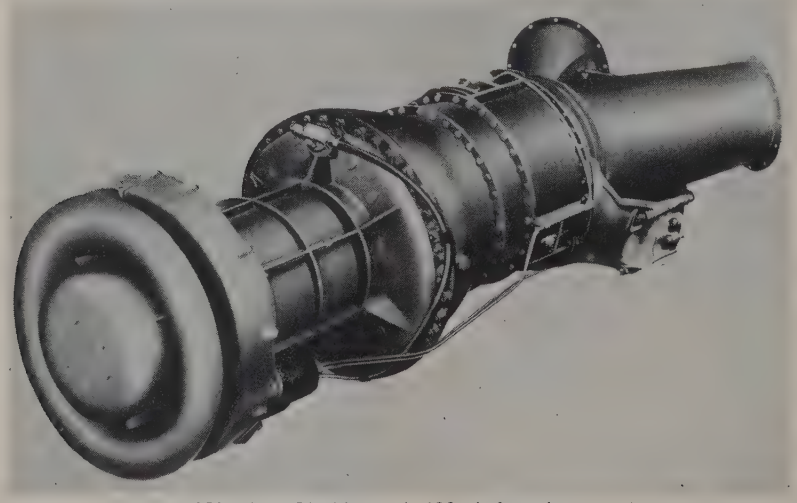
LUBRICATION SYSTEM.—Gear type compound pressure and scavenge pump, full flow filter and system of oil strainers.

DIMENSIONS.—
Overall length 60.0 in. (1,524 mm.).
Max. diameter 20.0 in. (508 mm.).

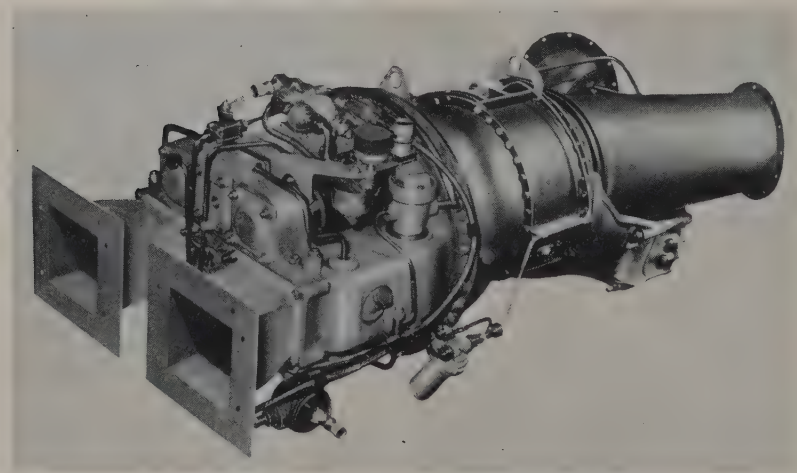
WEIGHT.—
Dry approx. 390 lb. (177 kg.).

PERFORMANCE RATING.—
Max. output 950 s.h.p.

CONSUMPTION.—
At max. rating 0.66 lb./h.p./hr. (0.30 kg./h.p./hr.).



The 950 s.h.p. Blackburn A 129 shaft-turbine engine.



The 400 s.h.p. Blackburn-Turbomeca Turmo 600 shaft-turbine engine.

THE BLACKBURN-TURBOMECA TURMO 600.

The Turmo is a shaft-turbine in which the exhaust products from the gas generator are absorbed by a second-stage free-turbine to drive an output flange at the rear of the engine.

A Palas turbojet forms the basis of the Turmo, which is available with a direct-drive output flange or with single, two or three-stage reduction gearboxes, giving in all a choice of ten different output speeds.

The free-turbine is bolted to a shaft which is splined either to the output shaft or to a shaft on which a pinion engages the appropriate reduction gear system. The free-turbine housing is bolted, in common with a gearbox support, to the rear flange of the rear bearing casing of the gas generator. Direct drive and two-stage reduction are on the engine

centre line; single-stage and three-stage reduction results in the output flange being offset 5 in. (12.7 cm.) below the engine centre-line.

The exhaust duct is bifurcated immediately aft of the free-turbine.

An additional oil pump, serving the free-turbine and reduction gear, is mounted on the lower accessories gearbox.

The chief virtues of the Turmo free-turbine are the elimination of heavy and complicated clutch mechanisms and the development of maximum torque under conditions of maximum load. It has completed successfully an Anglo-American type test and two Turmos have been supplied to the Kaman Aircraft Corporation of Bloomfield, Connecticut, for installation in the K-600-4 helicopter.

DIMENSIONS (Direct drive).—
Overall length 45.6 in. (1,158 mm.).
Overall width 26.4 in. (671 mm.).
Overall height 18.25 in. (463 mm.).

DIMENSIONS (Single-stage reduction).—
Overall length 49.0 in. (1,245 mm.).
Overall width 26.4 in. (671 mm.).
Overall height 19.25 in. (489 mm.).

DIMENSIONS (Two-stage reduction).—
Same as single-stage, except:
Overall length 52.4 in. (1,331 mm.).

DIMENSIONS (Three-stage reduction).—
Same as single-stage, except:
Overall length 56.2 in. (1,427 mm.).

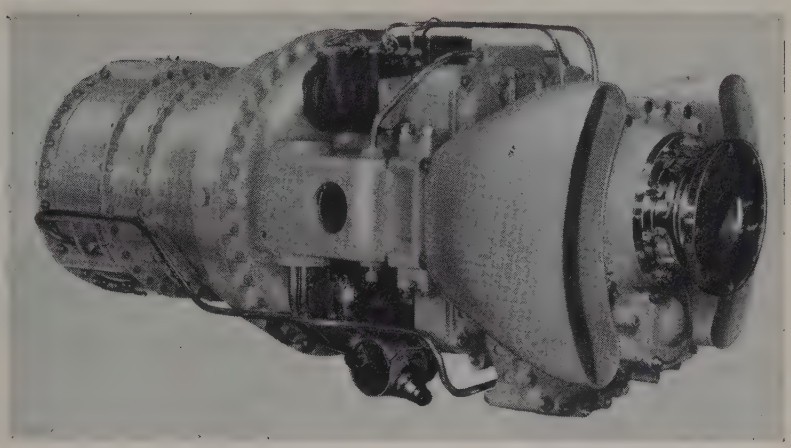
WEIGHT DRY.—
Direct-drive 234 lb. (106 kg.).
Single-stage reduction 271 lb. (123 kg.).
Two-stage reduction 313 lb. (142 kg.).
Three-stage reduction 343 lb. (156 kg.).

PERFORMANCE RATINGS.—
Max. rating 400 s.h.p.
Max. continuous 350 s.h.p.

CONSUMPTIONS.—
Fuel at max. rating 470 lb./hr. (213 kg./hr.).
Fuel at max. continuous rating 425 lb./hr. (193 kg./hr.).

THE BLACKBURN-TURBOMECA ARTOUSTE 600.

The Artouste 600 is a shaft-turbine of which the gas generator section is similar to the Palas unit but has a two-stage turbine and a modified engine fuel inlet to allow forward shaft power take-off. Shaft power in excess of the compressor requirements is available on a forward extension of the rotor shaft driving through a reduction gearbox. The standard reduction gearboxes as used on the Turmo may be fitted to the Artouste, through the medium of a mounting adapter on the front face of the air intake casing.



The 475 s.h.p. Blackburn-Turbomeca Artouste 600 shaft-turbine engine.

One application of the Artouste, which has been developed under Ministry of Supply contract, is as an airborne auxiliary power-plant for large military aircraft. It is designated the BnA.1.

Auxiliary power plants of this type, designated Artouste 510, are being supplied for installation in the Canadair CL-44 transport. Each is a combination of the Artouste 600 and Palouste, giving both shaft drive and compressed air bleed.

The following details apply to the Artouste 600.

DIMENSIONS.—
Max. diameter 19.25 in. (490 mm.).
Length, single-stage reduction 36.6 in. (930 mm.).
Length, two-stage reduction 40.0 in. (1,016 mm.).
Length, three-stage reduction 43.8 in. (1,113 mm.).

WEIGHTS, DRY.—
Single-stage reduction 255 lb. (116 kg.).
Two-stage reduction 285 lb. (129 kg.).
Three-stage reduction 315 lb. (143 kg.).

PERFORMANCE RATINGS.—
Max. rating 475 s.h.p.
Max. continuous rating 414 s.h.p.

CONSUMPTIONS.—
Fuel at max. rating 470 lb./hr. (213 kg./hr.).
Fuel at max. continuous rating 425 lb./hr. (193 kg./hr.).

THE BLACKBURN-TURBOMECA PALOUSTE 500.

The Palouste is an air generator which, as its name implies, is made up of components of the Palas and Artouste. The two-stage turbine is used to drive an oversize compressor, delivering more air than can be utilised by the turbines. Surplus air is bled off through an air delivery valve in the main casing, which is double-skinned with a perforated inner wall. Pressure ratio is 3.88 : 1.

The Palouste is installed in the Fairey Ultra-light helicopter, providing compressed air to the pressure jets at the tips of the rotor blades. Other applications are in the Blackburn low-pressure air-starting trolley and air starting pod. The military versions are designated BnPe.2 and 3.

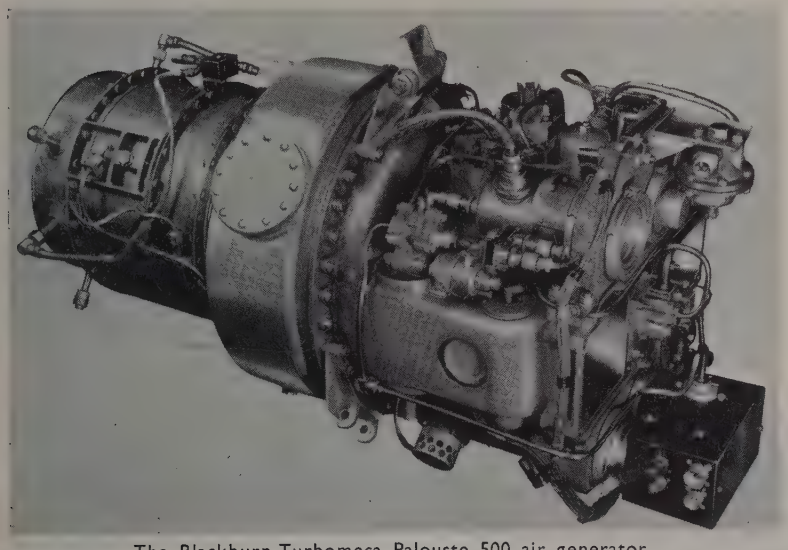
A high-pressure version of the Palouste with a compression ratio of 5.4 : 1 is under development.

DIMENSIONS.—
Overall length 33.5 in. (851 mm.).
Max. diameter 21.4 in. (543 mm.).

NET DRY WEIGHT.—
204 lb. (93 kg.).

PERFORMANCE RATING.—
Max. output 2.71 lb. air/sec. (1.23 kg./sec.).

CONSUMPTION.—
At max. output 330 lb./hr. (150 kg./hr.).



The Blackburn-Turbomeca Palouste 500 air generator.

BRISTOL SIDDELEY

BRISTOL SIDDELEY ENGINES, LTD.

HEAD OFFICE: ORMONDE HOUSE, 26-7, ST. JAMES'S STREET, LONDON, S.W.1.

Directors: Sir Arnold Hall, F.R.S., M.A., F.R.Ae.S. (Chairman); Air Commodore F. R. Banks, C.B., O.B.E., F.R.Ae.S. (Vice-Chairman); Air Chief Marshal Sir W. Alec Coryton, K.C.B., K.B.E., D.F.C.; H. T. Chapman, C.B.E., M.I.Mech.E., F.R.Ae.S.; Dr. S. G. Hooker, O.B.E., A.R.C.Sc., B.Sc., D.I.C., D.Phil., M.I.Mech.E., F.R.Ae.S.; W. F. Saxton, M.B.E.; G. L. Hack, M.I.Mech.E.; W. H. Lindsey, M.A., F.R.Ae.S.

Secretary: Sir Mark Norman, Bt.

Formation of this company, to co-ordinate the activities of Bristol Aero-Engines Ltd. and Armstrong Siddeley Motors Ltd., was announced in April, 1958.

Owned jointly and equally by The Bristol Aeroplane Co. Ltd. and Hawker Siddeley Group Ltd., the new company will undertake the development of new projects supported by the Ministry of Supply, will submit proposals and accept contracts, and utilise the research, engineering and manufacturing resources of Armstrong Siddeley and Bristol Aero-Engines. There will be a complete exchange of technical information between these two companies, which will, however, retain their separate identities.

BRISTOL

BRISTOL AERO-ENGINES, LTD.

HEAD OFFICE, WORKS AND AERODROME: FILTON, NR. BRISTOL.

LONDON OFFICE: 6, ARLINGTON STREET, ST. JAMES'S, LONDON, S.W.1.

Directors: Sir W. Alec Coryton, K.C.B., K.B.E., M.V.O., D.F.C. (Chairman and Managing Director); Sir W. Reginald Verdon Smith, M.A., B.C.L., J.P.; Brian Davidson; F. R. Banks, C.B., O.B.E., F.R.Ae.S., M.I.Mech.E., F.Inst.Pet.; Dr. S. G. Hooker, O.B.E., D.Phil., D.I.C., F.R.Ae.S. (Chief Engineer); G. L. Hack, M.I.Mech.E. (Works Director); John Innes, O.B.E. (Business Director); R. L. Ninnes, F.R.Ae.S.; Dr. E. Warlow Davies, D.Phil., B.A., B.Sc. (Deputy Chief Engineer); F. M. Burns (Financial Director).

General Manager: D. A. Fairnie, B.Sc., M.I.Prod.E.

Secretary: D. Railton.

With the progressive growth of the company's aviation activities at home and abroad, the Bristol Aeroplane Co., Ltd. decided late in 1955 to transfer the activities of its individual divisions to the control of separate subsidiary companies. As part of this reorganisation a new company known as Bristol Aero-Engines, Ltd. was incorporated. It took over the assets and liabilities of the Aero-Engine Division on January 1, 1956.

Subsequently, the activities of Bristol Aero-Engines Ltd. have been co-ordinated in certain respects with those of Armstrong Siddeley Motors Ltd. in the newly-formed company named Bristol Siddeley Engines, Ltd.

In addition to the headquarters factory at Filton, Bristol Aero-Engines Ltd. has a components factory at Sunderland, overhaul base at Whitchurch and satellite drawing offices in London and Cardiff.

Development of the Orion supercharged turboprop was abandoned as a Government economy measure in 1957; but the Proteus turboprop is proving capable of extensive development. Details were released in 1958 of the new Proteus 760 series, which will, in due course, replace the Proteus 750 series in the Britannia aircraft operated by certain airlines, including B.O.A.C.

The Olympus "two-spool" turbojet continues in production to power Avro Vulcan bombers for the R.A.F., and the Mk. 200 version of this engine has been chosen for the more advanced Vulcan B. Mk. 2.

Quantity production of the "single-spool" lightweight Orpheus turbojet is also under way. This engine powers all versions of the Folland Gnat and Fiat G.91 light fighters, as well as the Dassault Etendard VI, Breguet Taon, Lockheed JetStar and Fuji T1F-2. It is specified for the Short SB-5 research aircraft, Aerfer Leone, Hispano HA-300 and other aircraft of which few details may be published, and has been offered as an alternative power plant in the Sud-Aviation Baroudeur, Dassault Etondard IV and North American NAA-249 trainer.

Bristol is also developing supersonic ramjets for a wide range of applications, especially in the guided missile field.

The first ramjet to go into production in the United Kingdom was the Bristol Thor, and ramjets of this type power the Bristol/Ferranti Bloodhound surface-to-air missile. A larger, more advanced ramjet, designated BRJ-801, was announced in 1957.

Bristol holds licences to manufacture afterburners and associated equipment designed and developed by the Solar Aircraft Company of San Diego, California, and the thrust-reversing system developed by the French SNECMA company.

The Curtiss-Wright Corporation has collaborated with Bristol over a long period in connection with the production of Bristol gas-turbine engines in the United States, and in July, 1957 there was announced a new agreement concerning a civil version of the Olympus turbojet, known as the Zephyr, which is intended "for jet transport aircraft for all weather operation" out of present commercial airports. Curtiss-Wright also has an agreement with Bristol to manufacture a derivative of the Orpheus developed jointly by the two companies under the designation TJ-37.

In November, 1956 it was announced that the Indian Government had concluded an agreement with Bristol Aero-Engines Ltd. covering the manufacture in India of the whole range of Orpheus engines. The Orpheus will be built at Bangalore, and the first application for Indian-built Orpheus engines will be in the Folland Gnat, which is to be built under licence by Hindustan Aircraft Ltd.

Fiat SpA of Turin concluded an agreement in December, 1957 for manufacture of the Orpheus in Italy; and the French SNECMA company also has a licence agreement in respect of this engine.

THE BRISTOL OLYMPUS

The Olympus was the first British turbojet engine of the "compound" or "two-spool" type.

The engine consists basically of a low-pressure system and a high-pressure system. The high-pressure system has a compressor, combustion section and turbine, and may therefore be thought of as a complete gas-turbine engine. On an entirely separate shaft, the low-pressure system has a compressor fed from the atmosphere and delivering to the H.P. compressor.

The low-pressure compressor is driven by a low-pressure turbine which receives gas from the H.P. turbine and discharges to the jet pipe. By strict analogy the L.P. section therefore acts as an exhaust-driven supercharger for the H.P. section.

In this way, a high pressure ratio can be achieved while retaining ease of starting and handling as good as that of the best single-shaft low-pressure-ratio engine, which results in exceptional power and fuel economy for the weight and size of the engine. This is especially the case at high altitudes, as evidenced by the fact that an Olympus-powered Canberra established successive World's Altitude Records in May, 1953 and August, 1955.

Several versions of the Olympus have been announced, as follows:—

BOl.1. Initial version with S/L. rating of 9,140 lb. (4,146 kg.). First bench-tested on May 6, 1950, but only limited development.

BOl.2. Development of BOl.1 with larger turbine and modified compressor. Designed to give 9,750 lb. (4,423 kg.) s.t. Not built.

BOl.1/2. Development of BOl.2, first run in November, 1950.

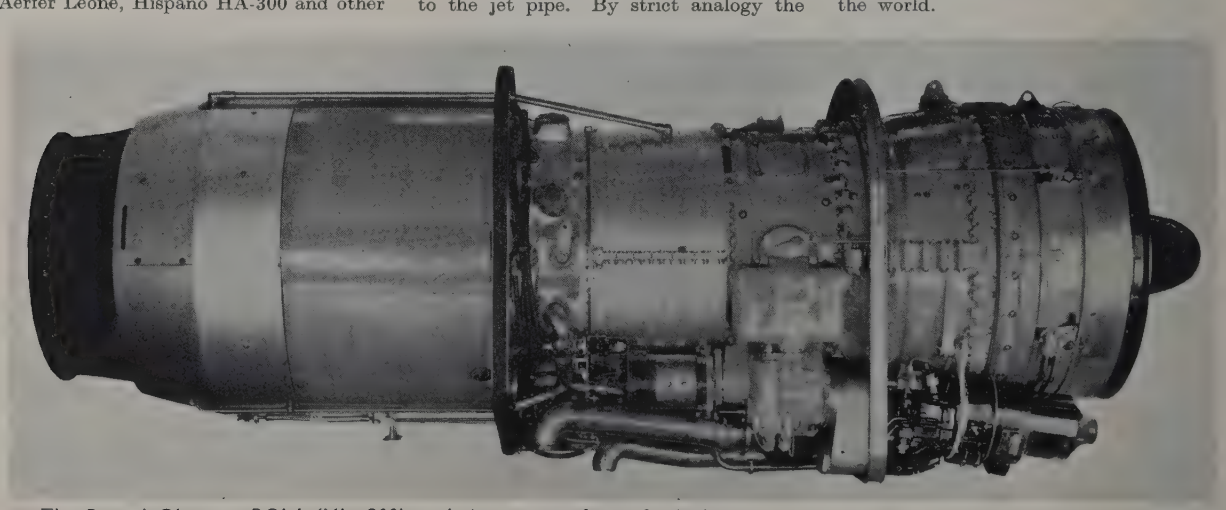
BOl.1/2A. Modified version of BOl.1/2 to meet requirements of Curtiss-Wright, holders of U.S. licence. Rated at 9,750 lb. (4,423 kg.) s.t., with compression ratio of 9 : 1 and air mass flow of 165 lb./sec. (75 kg./sec.).

BOl.1/2B (Mk. 100). First version of Olympus to be test flown, in a modified Canberra B.2 aircraft on August 5, 1952. Accessories moved forward from delivery casing of H.P. compressor to intermediate casing. Tested initially in de-rated (8,000 lb. = 3,629 kg. s.t.) form as Olympus Mk. 99. Slightly modified Mk. 100 version (9,250 lb. = 4,196 kg. s.t.) powered second prototype Avro Vulcan, first flown in September, 1953. Rated power 9,750 lb. (4,423 kg.) s.t.

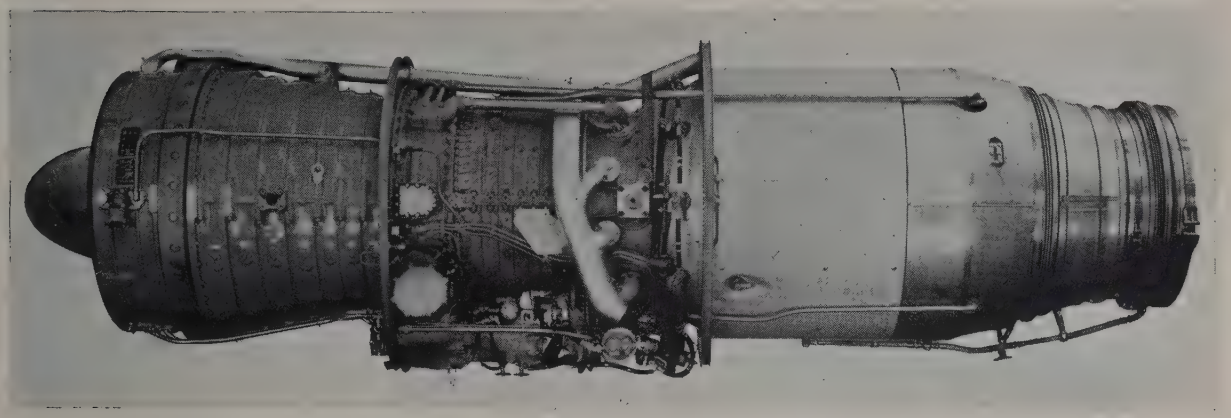
BOl.1/2C (Mk. 101). First version of the Olympus to enter full production, for the Avro Vulcan B. Mk. 1. Flight tested in a Canberra in June, 1954. Type-tested at a rating of 11,000 lb. (4,990 kg.) s.t. in December, 1954. Similar to the BOl.1/2B except for larger-diameter turbine casing.

BOl.6 (Mk. 200). First of a new series of Olympus turbojets. Type tested at a rating of 16,000 lb. (7,260 kg.) s.t. in January, 1957, thrusts of over 17,300 lb. (7,846 kg.) being recorded during the test. Extensively redesigned and smaller in diameter than earlier versions. Claimed to have the highest thrust/weight ratio of any high-thrust turbojet, combined with very low specific fuel consumption. In production for Avro Vulcan B.2 as Olympus Mk. 200.

BOl.7 (Mk. 201). Developed from the BOl.6, this engine passed its official military type-test at 17,000 lb. (7,710 kg.) s.t. in mid-1958. It is claimed to have the highest thrust/weight ratio of any type-tested high-thrust turbojet in the world.



The Bristol Olympus BOl.6 (Mk. 200) turbojet engine, four of which will power the Avro Vulcan B. Mk. 2 bomber.



The Bristol Olympus BOl.12 (Mk. 104), four of which power the Avro Vulcan B. Mk. 1 bomber.

BOl.7R. Similar to BOl.7, but fitted with Bristol-Solar fully-variable afterburning, giving maximum thrust of 24,000 lb. (10,885 kg.).

BOl.11. (Mk. 102). Similar externally to the Mk. 101, from which it has been developed. Used in the Avro Vulcan B. Mk. 1 bomber. It was announced in February, 1956 that this engine had been type tested at a rating of 12,000 lb. (5,443 kg.) s.t. Two Olympus Mk. 102 engines were fitted in the Canberra which established a World's Height Record for aeroplanes of 65,890 ft. (20,083 m.) in August, 1955.

BOl.12 (Mk. 104). Announced in March, 1957 after being type-tested at rating of 13,000 lb. (5,897 kg.) s.t. in December, 1956. Engines of Mk. 101 and Mk. 102 type can be converted to Mk. 104 standard on overhaul at relatively small cost. In production for the Avro Vulcan B. Mk. 1.

Since 1955, Solar Aircraft of San Diego, U.S.A., have been assisting in the design and development of reheat systems for the Olympus and other Bristol turbojets. A Series 100 Olympus completed in 1957 the equivalent of a 150-hour type test with a Solar reheat system giving a 40% increased thrust. Thrust and nozzle area can be varied continuously and progressively.

The following data apply specifically to the Olympus BOl.11 (Mk. 102).—

TYPE.—Axial-flow "two spool" turbojet.

AIR INTAKE.—One-piece magnesium-zirconium alloy casting, with five radial struts supporting housing for front main bearing. Houses ring of inlet guide vanes.

L.P. COMPRESSOR.—Seven-stage axial-flow type. Made up of seven rotor discs, of which one is steel and the others light alloy. Discs are sandwiched between compressor drive shaft and front stubshaft, and are located by tubular dowels threaded over the eight through-bolts which clamp assembly together. Compressor blades are secured in discs by "fir tree" roots. Casing is made from a light alloy casting in two sections, split on a diameter. Seven rows of aluminium alloy stator blades and single row of outlet guide vanes are retained in casing by dovetail roots.

INTERMEDIATE CASING.—Magnesium-zirconium casting, carrying rear bearing of L.P. compressor and front bearing of H.P. compressor. Mounting faces for accessories provided on this casing in two groups.

H.P. COMPRESSOR.—Eight-stage axial-flow type. Construction similar to that of L.P. compressor, but with steel widely used rather than light alloy. Two-piece stator casing, rotor discs and blades are all of steel. Discs located radially relative to each other by Hirth couplings on each disc boss and axially by a nut on the driveshaft which holds discs in compression. Rotor blades, entry guide vanes, stator blades and two rows of outlet guide vanes are all of steel and are cantilever-mounted in same way as those of L.P. compressor.

DELIVERY CASING.—Inner and outer casings of sheet steel joined by ten radial struts to form very rigid structure. Inner wall supports rear bearing of H.P. compressor. Outer wall carries main engine-mounting trunnions.

COMBUSTION CHAMBER.—"Cannular" type, with inner and outer casings forming an annular space which contains ten flame tubes. Outer casing comprises front, centre and rear units, the centre unit being cylindrical and split on horizontal centreline for easy access to flame tubes. Front section carries forward ends of flame tubes and duplex burners. Rear section encloses H.P. turbine stator blades and rotor.

FUEL SYSTEM.—High-pressure swashplate-type pump feeds duplex burners via air/fuel ratio control, full-range flow control and flow distributor. Governors are provided to limit maximum rotational speed and to control cruising rotational speed.

H.P. TURBINE.—Single-stage. Rotor blades have shrouded tips and are attached to discs by "fir tree" roots. Stator blades are precision cast in segments of four and mounted in turbine casing, which is bolted to separate L.P. turbine casing and is surrounded by a thin heat-shield. Shaft is mounted in two bearings.

L.P. TURBINE.—Single-stage with similar construction to H.P. Turbine. L.P. stator blades are dogged at inner ends to an interstage seal.

JET PIPE.—Fixed type.

ACCESSORY DRIVE.—Accessories are mounted in two groups on intermediate casing. One group is driven from L.P. compressor. Other group, driven from H.P. compressor, includes fuel pump and oil pressure and scavenge pumps.

LUBRICATION SYSTEM.—Closed system. Main pressure pump feeds bearings through calibrated orifices. Gravity drainage to sumps under intermediate and delivery casings; scavenge pump feed back to main oil tank.

MOUNTING. — Four-point suspension, with trunnions on each side of L.P. compressor casing and on each side of delivery casing.

STARTING.—Electric starter on port side of intermediate casing.

DIMENSIONS (Olympus 101).—
Max. diameter 40.9 in. (1,039 mm.).
Length 128.0 in. (2,611 mm.).

DIMENSIONS (Olympus 102 and 104).—
Max. diameter 42.4 in. (1,077 mm.).
Length 132.0 in. (3,350 mm.).

DIMENSIONS (Olympus 200).—
Max. diameter 41.75 in. (1,060 mm.).
Length 126.4 in. (3,210 mm.).

WEIGHT (Olympus 101).—
3,600 lb. (1,632 kg.).

WEIGHT (Olympus 102).—
3,800 lb. (1,723 kg.).

PERFORMANCE (Olympus 101).—
Max. thrust 11,000 lb. (4,990 kg.).
Cruising thrust 8,000 lb. (3,630 kg.).

PERFORMANCE (Olympus 102).—
Max. thrust 12,000 lb. (5,443 kg.).

PERFORMANCE (Olympus 104).—
Max. thrust 13,000 lb. (5,897 kg.).

PERFORMANCE (Olympus 200).—
Max. thrust 16,000 lb. (7,260 kg.).

FUEL CONSUMPTION (Olympus 101).—
At max. power 0.80 lb./lb. thrust/hr. (0.80 kg./kg. thrust/hr.).
At cruising power 0.75 lb./lb. thrust/hr. (0.75 kg./kg. thrust/hr.).

THE BRISTOL ZEPHYR.

The Zephyr turbojet has been developed from the Olympus for civil use jointly by Bristol and the American Curtiss-Wright Corporation. Details are given under "Wright" in the U.S. section of this work.

THE BRISTOL ORPHEUS.

The Orpheus is a single-spool turbojet engine which was initiated in 1953 by the Bristol company as a private venture, to meet the requirement for an engine in the medium thrust range for applications where low weight and small frontal area are of prime importance.

The Orpheus has a seven-stage compressor, annular combustion chamber with separate flame tubes and single-stage turbine. Acceleration from idling to maximum power is said to be possible in under four seconds without stalling or surge.

The BOr.1 version of the Orpheus, which first ran on December 17, 1954, successfully completed a 150-hour type test in the Spring of 1955, at an initial rating of 3,285 lb. (1,490 kg.) equivalent to 4.4 lb. thrust per lb. of engine weight. It was first flown in the prototype Folland Gnat Mk. 1, on July 18, 1955.

The rapidity of the design and manufacture of the first engines has been matched by the speed with which the Orpheus has been developed to higher ratings, and the following versions have been announced :—

BOr.1. Now rated at 4,050 lb. (1,837 kg.) s.t., following type test at this figure in January, 1956. Flown in prototype Fiat G.91, Lockheed JetStar, Fuji T1F-2 and Dassault Etendard VI, as well as Folland Gnat Mk. 1.

BOr.2 (Orpheus 701). Type-tested in November, 1956 at rating of 4,520 lb. (2,050 kg.) and with improved altitude performance. In production, primarily for Folland Gnat Mk. 1.

BOr.3 (Orpheus 801). Type tested in May, 1957 at rating of 4,850 lb. (2,200 kg.) s.t. for a weight of 825 lb. (374 kg.), giving thrust/weight ratio of 5.9 : 1, the highest figure for any contemporary turbojet. Almost identical to BOr.2 except for accessories. Used in the Fiat G.91, Dassault Etendard VI and Breguet 1001 Taon. Specified for Lockheed JetStar and Short SB-5.

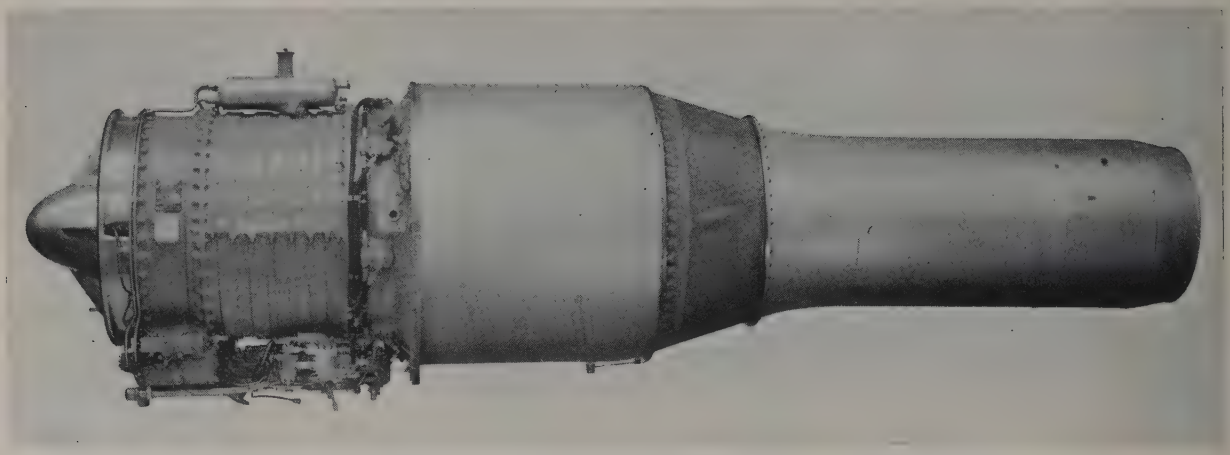
BOr.4. Similar to BOr.3. De-rated to 4,230 lb. (1,919 kg.) s.t., giving reduced fuel consumption and longer engine life. Intended for use in transport and training aircraft. Specified for Folland Gnat trainer.

BOr.11. Development of BOr.3. Rating increased to 5,760 lb. (2,613 kg.) s.t. for very small increase in weight. Announced in March, 1957.

BOr.12. Further development of BOr.3 for NATO light fighters. Rated at 6,810 lb. (3,089 kg.) s.t., or 8,000 lb. (3,628 kg.) s.t. with reheat.

In addition to the types of aircraft mentioned above, the Orpheus has been specified for the Aerfer Leone and Hispano HA-300 fighters, the Fiat G.91T trainer and other advanced projects.

The Orpheus is being developed under Ministry of Supply contract in connection with the joint Mutual Weapons Development Programme agreement between the



The Bristol Orpheus BOr.2 (Mk. 701) turbojet engine (4,520 lb.=2,050 kg. s.t.).

United States and the United Kingdom. It is the only engine selected for development under this programme with the aid of U.S. funds.

The Orpheus will be manufactured under licence at Bangalore, India, by Hindustan Aircraft Limited, initially to power Indian-built Folland Gnats. Under an agreement with the Curtiss-Wright Corporation, a version is to be developed jointly by Bristol and the Wright Aeronautical Division, under the designation TJ-37, for U.S. production.

In Italy, Fiat concluded a manufacturing agreement in respect of the Orpheus in December, 1957, and production in Italy will be devoted primarily to the Fiat G.91 programme. The French engine manufacturer, SNECMA, has also concluded an agreement with Bristol for production of the Orpheus.

The following data apply specifically to the Orpheus 801 (BOr.3).—

TYPE.—Axial-flow lightweight turbojet.

AIR INTAKE DUCT.—Fabricated from light alloy, with cartridge starter housed in centrebody.

AIR INTAKE CASING.—Casting in ZRE magnesium-zirconium alloy, housing front bearing and having integral gear chamber for accessory drives.

COMPRESSOR.—Seven-stage axial-flow type. Aluminium alloy rotor blades attached by "fir tree" roots to seven aluminium alloy rotor discs separated by spacer rings, the assembly being secured by through bolts. Fixed-incidence inlet guide vanes mounted in air intake casing. Six rows of stator blades mounted in dove-tail grooves in two-part ZRE stator casing, all but two rows of stator blades being of aluminium alloy.

DELIVERY CASING.—Aluminium alloy casting having inner and outer portions joined by seven radial struts, between which are mounted the seven burners. The delivery casing houses the compressor outlet guide vanes, and also carries the two igniter plugs and air tapping connections.

COMBUSTION CHAMBER.—"Cannular" type, with inner and outer casings of heat-resistant steel containing seven flame tubes. Each flame tube comprises an integral turbine stator segment, adjacent segments being bolted together to form complete annulus.

FUEL SYSTEM.—Comprises Lucas variable-stroke pump, combined control unit including a unitary throttle and shut-off cock, flow distributor and barometric pressure control, together with air/fuel ratio control and overspeed governor. Duplex burners.

NOZZLE GUIDE VANES.—Integral with flame tubes, nine hollow blades being welded in position in each stator segment.

TURBINE.—Single-stage axial-flow type having 125 unshrouded blades, mounted in disc rim by "fir tree" fixings.

JET PIPE.—Welded steel construction, secured to exhaust cone flange. Surrounded by Refrasil heat-insulating blanket and fitted with thermocouple bosses. Jet pipe and exhaust cone are surrounded by light-alloy shroud forming annular cooling air space.

ACCESSORY DRIVES.—Gear chamber integral with lower portion of air intake casing provides drives for fuel pump, two hydraulic pumps, electric generator, tachometer and oil pump. Drive from main rotor via bevel gears and shaft through lower vertical strut in intake casing.

LUBRICATION SYSTEM.—Comprises main pressure pump, metering pump and two scavenge pumps. Oil from pressure pump is led to front bearing and metering pump, the latter supplying accessory drives and rear bearing, oil from which is exhausted into jet efflux. Scavenge oil from front bearing and accessory drives is returned to tank.

MOUNTING.—Three-point suspension, with main trunnions on each side of delivery casing and tie link from forward face of gear casing.

STARTING.—Twin-breech cartridge starter, the breeches being mounted on the starboard side of the compressor casing and the starter mechanism within the nose bullet of the intake duct.

DIMENSIONS.—
Diameter 32.4 in. (823 mm.), length (BOr.1 and 2) 73.0 in. (1,854 mm.), length (BOr.3) 75.45 in. (1,916 mm.), length (BOr.4) 75.5 in. (1,919 mm.), length (BOr.11) 79.27 in. (2,013 mm.), length (BOr.12) 82.7 in. (2,100 mm.).

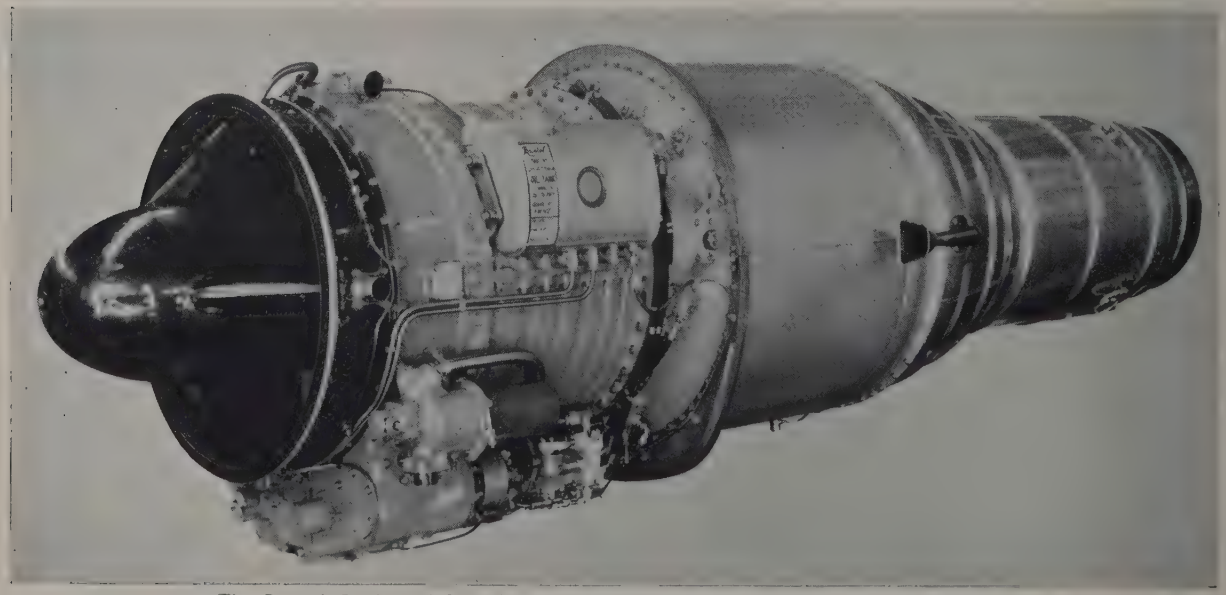
WEIGHTS.—
BOr.1 750 lb. (340 kg.), BOr.2 790 lb. (358 kg.), BOr.3 825 lb. (374 kg.), BOr.4 890 lb. (404 kg.), BOr.11 985 lb. (447 kg.), BOr.12 1,100 lb. (499 kg.).

CONSUMPTIONS (BOr.2 and 3).—
At max. power 1.065 lb./lb. s.t./hr. (1.065 kg./kg. s.t./hr.).

THE BRISTOL PROTEUS 700 SERIES

The first production version of the Proteus is designated the 700 Series. This series includes the Mk. 705, which powers the Britannia 102 airliners in service with B.O.A.C.

The general arrangement of the engine is such that air enters the compressor through a casing to the rear of the combustion chambers, passing forward



The Bristol Orpheus BOr.3 (Mk. 801) turbojet engine (4,850 lb.=2,200 kg. s.t.).

through the axial section of the compressor to the final centrifugal stage. In the diffuser of the centrifugal stage the air is turned rearwards to enter the combustion chambers, which surround the axial-flow portion of the compressor. The hot gas then passes through "tunnels" in the above-mentioned casing to the two-stage compressor-driving turbine, which is immediately followed by the two-stage power turbine. After passing through the power turbine the hot gas is exhausted rearwards through the jet pipe.

The power turbine is mechanically independent of the compressor-driving turbine, and drives a two-stage epicyclic reduction gear through a shaft which runs coaxially within the shaft carrying the compressor and its associated turbine. The airscrew shaft forms a unit with the planet carrier of the reduction gear, while the annulus gear has associated with it a hydraulic torquemeter, through which the reaction on the annulus is transmitted to the casing. A parking brake is incorporated to prevent the airscrew of a parked aircraft from being windmilled.

The Proteus 705 first ran in May, 1952, and completed its first official type test in July of the following year. In August, 1953, it flew for the first time in a Britannia, and was officially type-tested at 3,900 e.h.p. in August, 1954, to provide official approval for this rating which is employed in the Britannia 102 in B.O.A.C. service.

During proving flights, a form of engine malfunctioning was encountered which only occurred in certain rare meteorological conditions. Considerable difficulty was experienced in reproducing these conditions, either on the test bench or in flight, but extensive flight trials established that the momentary drop in engine speed which had been observed, sometimes resulting in flame extinction, was caused by an unusual form of ice formation in the air intake. Thereafter it was a relatively simple matter to incorporate the necessary modifications in the powerplant.

On entering airline service in February, 1957, the Proteus 705 engine had a permitted life between overhauls of 500 hours. Within a month the overhaul life had been extended to 650 hours, and in September, 1957, approval was given for the extension of the life to 1,050 hours. By March, 1958, when 175,000 hours flying had been completed in airline service, the life was extended to 1,300 hours and there was a further increase to 1,600 hours in July, 1958. This rate of increase of overhaul life is believed to be more rapid than that of any other engine, piston or turbine.

TYPE.—Reverse-flow turboprop engine.

AIRSCREW DRIVE.—Compound epicyclic reduction gear with drive from free turbine. Ratios 11.111 or 0.09 : 1.

AIR INTAKE.—Radial type between compressor and turbine sections. The intake is a single light alloy casting and is a full structural member of the engine body. Provision for de-icing.

COMPRESSOR.—Twelve axial stages followed by a single centrifugal stage. Axial rotor made up of twelve discs secured by through-bolts. Rotor blades (714) secured in axial grooves of "fir-tree" section. Stator blades (644) held in circumferential grooves of "dovetail" section in light alloy two-piece casing. Single steel centrifugal impeller has 31 vanes and is flanged and bolted to shaft. Radial diffuser of high-temperature aluminium-alloy directs air to eight transfer ducts leading to combustion chambers. Compression ratio 7.2 : 1. Mass air flow 42.92 lb. (19.47 kg.) per sec.

COMBUSTION CHAMBERS.—Eight tubular chambers of mild steel with concentrically mounted flame tubes of Nimonic alloy. Lucas Simplex burners with downstream injection. K.L.G. igniter plugs in primary zone of two flame tubes. Rotax H.T. booster coil. Four glow-plugs in alternate chambers.

FUEL SYSTEM.—Lucas system incorporating fuel pump, throttle valve, barometric pressure control, H.P. shut-off cock and burners. Maximum fuel pressure 1,400 lb./sq. in. (98.4 kg./cm.²).

FUEL GRADE.—DERD 2482.

NOZZLE GUIDE VANES.—Eighty Nimonic alloy blades precision cast in segments of 3 or 7 blades.

TURBINE.—Two separate two-stage axial-flow turbines, the first driving the compressor and the second the airscrew reduction gear through bore of compressor rotor. All blades machined from Nimonic alloy and secured to stainless steel rotor discs by "fir-tree" roots. 80 blades in first stage, 70 in second, 56 in third and 64 in fourth. Gas temperatures 872°C. before turbine, 500°C. after turbine.

JET PIPE.—Austenitic stainless steel jet pipe with fixed-area nozzle, surrounded by light alloy shroud.

ACCESSORY DRIVES.—From main reduction gear below engine to auxiliary box, which has drives for all accessories, including generator.

LUBRICATION SYSTEM.—Dry sump. Bristol gear type pump and accessories. Oil tank capacity 14 Imp. gallons, including air space and feathering compartment.

OIL SPECIFICATION.—DTD.2479.

MOUNTING.—Four-point mounting with pads in plane of centrifugal impeller.

STARTING.—Electric starter on gear case. Plessey starting pump.

DIMENSIONS.—
Overall diameter 40.1 in. (1,020 mm.).
Length (from cone fitting line to jet pipe attachment face) 100.6 in. (2,540 mm.).
Frontal area 8.5 sq. ft. (0.78 m.²).

NET DRY WEIGHT.—
3,065 lb. (1,390 kg.).

PERFORMANCE RATINGS.—
Take-off (static) 3,472 s.h.p. plus 1,090 lb. (495 kg.) jet thrust (=3,890 e.h.p.) at 11,700 compressor r.p.m. at sea level.
Max. continuous power 2,985 s.h.p. plus 985 lb. (447 kg.) jet thrust (=3,366 e.h.p.) at 11,350 compressor r.p.m. at sea level.

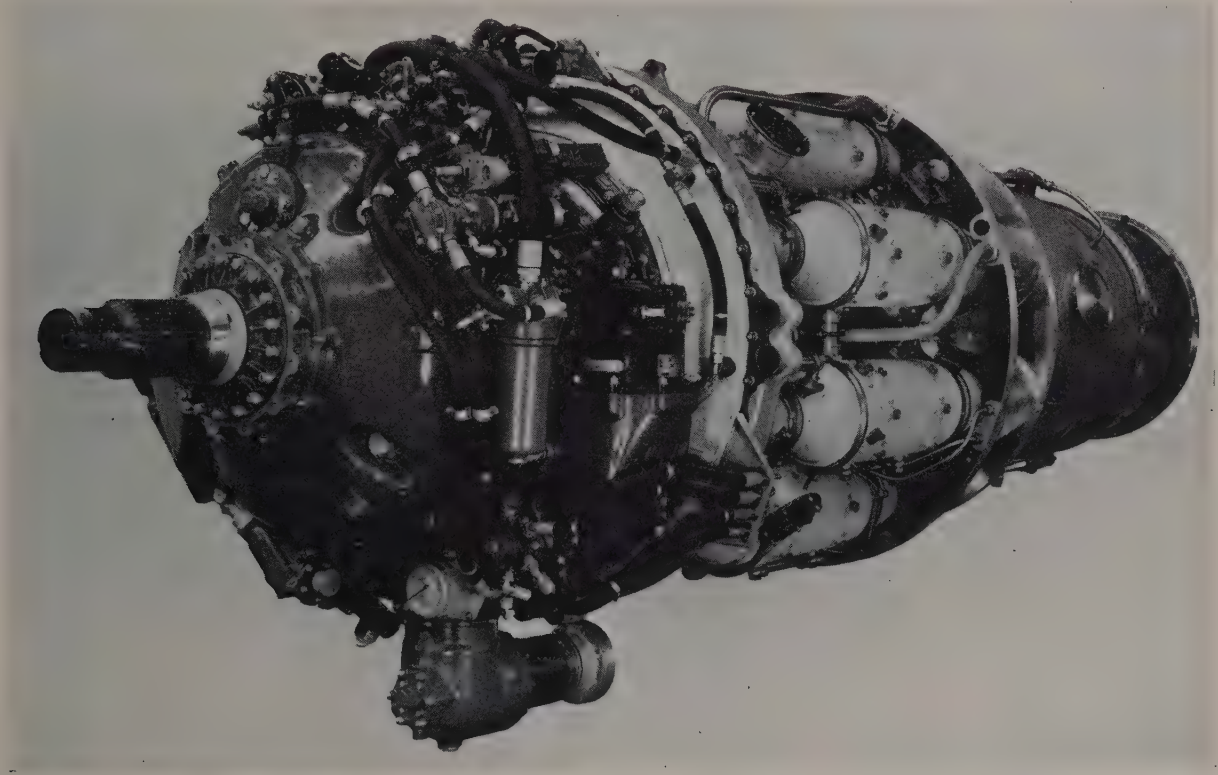
CONSUMPTIONS.—
Fuel 0.507 lb. (0.230 kg.) per e.h.p./hr. at max. continuous power at 345 m.p.h. (552 km.h.) and 35,000 ft. (10,700 m.).
Oil (max.) 2 pints (1.13 litres) per hour.

THE BRISTOL PROTEUS 750 SERIES.

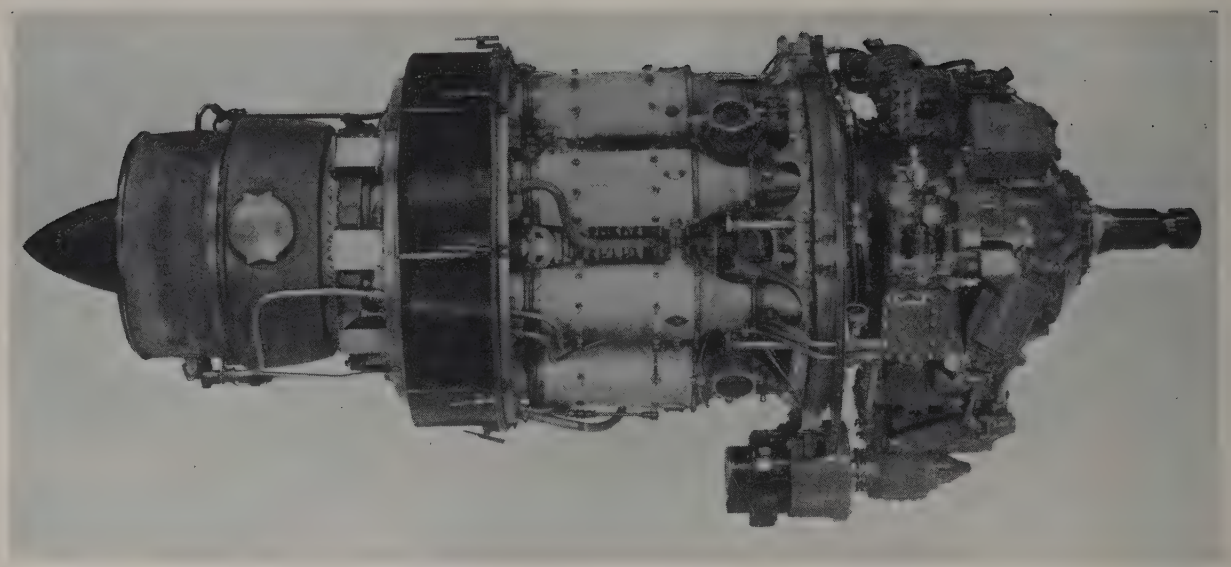
This is the first development derivative of the Proteus 700 Series, and includes the following versions :—

Proteus 755. This is the basic version, introduced into service in the Britannia 312's of B.O.A.C., Britannia 313's of El Al and Britannia 302's of Aeronaves de Mexico. It is externally very similar to the Proteus 705, but can be distinguished by the fact that the drive below the reduction gear carries a 47 kva alternator, as compared with the shaft drive to a remote accessory gearbox on the earlier engine.

Proteus 756. Similar to Proteus 755 except for minor modifications. Intended for Cubana Britannia 318's. Same rating as Proteus 755.



The Bristol Proteus 705 turboprop engine, four of which power the Britannia 102 airliner.



The Bristol Proteus 755 turboprop engine (3,705 s.h.p. plus 1,180 lb.=535 kg. jet thrust).

Proteus 757. As Proteus 765, plus water injection and fuel system modifications. For Hunting-Clan Britannia 317's. Rating as for 755.

Proteus 758. Similar to Proteus 755, except for 4,350 e.h.p. take-off rating. Other ratings as for 755. Modifications for conversion of 755 to 758 can be undertaken in field.

The following data apply to the Proteus 755 :—

DIMENSIONS.—
Overall diameter 40.1 in. (1,041 mm.).
Length 100.6 in. (2,540 mm.).

DRY WEIGHT (including turbine bleed manifold for airframe de-icing, but less exhaust cone) 2,900 lb. (1,315 kg.).

PERFORMANCE RATINGS.—
Take-off (static) 3,705 s.h.p. plus 1,180 lb. (535 kg.) jet thrust (=4,160 e.h.p.).
Max. continuous power (static) 3,485 s.h.p. plus 1,130 lb. (513 kg.) jet thrust (=3,920 e.h.p.).
Max. continuous power (installed) at 375 m.p.h. (604 km.h.) at 25,000 ft. (7,620 m.) 2,050 s.h.p. plus 357 lb. (162 kg.) jet thrust (=2,495 e.h.p.).

CONSUMPTIONS.—
Fuel at take-off power 0.68 lb. (0.308 kg.) per e.h.p./hr.
Fuel, at max. continuous power at 375 m.p.h. (604 km.h.) at 25,000 ft. (7,620 m.) 0.499 lb. (0.226 kg.) per e.h.p./hr.

THE BRISTOL PROTEUS 760 SERIES.

Second development of the Proteus 700 series, the Proteus 760 series incorporates an improved compressor, giving a mass flow of 44.9 lb./sec. (20.36 kg./sec.) compared with the 43.8 lb./sec. (19.87 kg./sec.) mass flow under S/L conditions of the 750 series.

The basic engine is the Mark 765, the Marks 761 and 762 being considered as intermediate steps. Proteus 755 power plants in Britannia aircraft may be replaced by Proteus 765 power plants in complete aircraft sets.

Following are the characteristics of the versions so far announced :—

Proteus 761. Physically identical to the Proteus 765, but derated to substantially the same power as the Proteus 755. It has a lower cruising specific fuel consumption than the Proteus 755.

The Proteus 761 installed in the last six of the 18 Britannia 312's for B.O.A.C. and will be fitted retrospectively in those aircraft already delivered. It is also to be fitted to the Britannia 300's and 310's operated by Aeronaves de Mexico, El Al, and Canadian Pacific Air Lines and to the Britannia 252's ordered by the Ministry of Supply.

Proteus 762. Similar to Proteus 761 except for 4,400 e.h.p. take-off rating. Other ratings as for Proteus 761. Modifications for conversion of 761 to 762 can be undertaken in field.

Proteus 765. Basic engine of the Proteus 760 series, the Proteus 765 will be fitted ultimately in the Britannia 300 and 310 series aircraft of Aeronaves de Mexico, B.O.A.C., El Al and Canadian Pacific Air Lines.

Proteus 766. Similar to Proteus 765 except for minor modifications.

PERFORMANCE RATINGS (Proteus 761).—
Take-off (static) 3,740 s.h.p. plus 1,220 lb. (553 kg.) jet thrust (=4,120 e.h.p.).
Max. continuous power (installed) at 375 m.p.h. (604 km.h.) at 25,000 ft. (7,620 m.) 2,090 s.h.p. plus 361 lb. (164 kg.) jet thrust (=2,540 e.h.p.).

PERFORMANCE RATINGS (Proteus 765).—
Take-off (static) 3,960 s.h.p. plus 1,260 lb. (572 kg.) jet thrust (=4,445 e.h.p.).
Max. continuous power (static) 3,526 s.h.p. plus 1,165 lb. (528 kg.) jet thrust (=3,970 e.h.p.).
Max. continuous power (installed) at 375 m.p.h. (604 km.h.) at 25,000 ft. (7,620 m.) 2,200 s.h.p. plus 380 lb. (172 kg.) jet thrust (=2,675 e.h.p.).

CONSUMPTION (Proteus 761).—
Fuel at max. continuous power (installed) at 375 m.p.h. (604 km.h.) at 25,000 ft. (7,620 m.) 0.486 lb. (0.220 kg.) per e.h.p./hr.

CONSUMPTION (Proteus 765).—
Fuel at take-off (static) 0.674 lb. (0.306 kg.) per e.h.p./hr.
Fuel at max. continuous power (installed) at 375 m.p.h. (604 km.h.) at 25,000 ft. (7,620 m.) 0.486 lb. (0.220 kg.) per e.h.p./hr.

THE BRISTOL PROTEUS 250 SERIES.

Power plant of the Britannia 253 for R.A.F. Transport Command, is the Proteus 255. This engine is similar to the Proteus 765, with the addition of water injection and fuel system modifications. Same ratings as Proteus 765.

THE BRISTOL THOR.

Bristol Aero-Engines have been working on problems of supersonic propulsion with ramjet engines since 1949. Several hundred test vehicles powered by ramjets of Bristol design have been fired at Aberporth and Woomera since 1952, reaching high supersonic speeds and altitudes beyond those at which conventional manned aircraft are operated. First production development of this programme is the Thor series of ramjets.

The Thor was the first ramjet power unit to go into production in Europe, and engines of this type power the Bristol/Ferranti Bloodhound surface-to-air guided missile which entered service with the Royal Air Force in 1958.

Few details of the construction of the Thor are available beyond those shown in the accompanying photograph, in which the true nose cone is not shown for security reasons. The Thor has a centre-body type intake of the two-shock type, supported by three equi-spaced faired struts, followed by an annular diffuser leading to the combustion system. Behind it is a series of fuel injection rods each with two or three downstream nozzles, and combustion is stabilised by means of baffles. The parallel tailpipe terminates in a convergent/divergent final nozzle which is cooled by means of a ring of apertures surrounding the rear portion of the tailpipe.

The Thor is designed for external pod mounting and has two mounting brackets, the rear mounting allowing for thermal expansion between the ramjet and the missile or aircraft. Fuel connections are made adjacent to the front mounting bracket.



The Bristol Thor Ramjet, two of which power the Bristol Bloodhound missile.

The fuel system used with the Thor consists of an air-turbine-driven centrifugal pump, a fuel/air ratio control, and a Mach number control to reduce the fuel supply when the selected Mach number is exceeded.

Ignition is at present achieved by pyrotechnic flares. Complete reliability of ignition of the ramjet unit is essential in a missile or test vehicle which is accelerated from standstill to ramjet-operating speed by booster rockets, and this has been achieved.

A typical 16 in. (400 mm.) ramjet can develop an effective thrust horsepower at sea level which rises from approximately 25,000 h.p. (about 6,000 lb.=2,720 kg. s.t.) at Mach 2 to about 130,000 h.p. (about 20,000 lb.=9,070 kg. s.t.) at Mach 3.0. Effective horsepower falls off with altitude and the same unit would deliver approximately 1,500 h.p. (about 600 lb.= 272 kg. s.t.) at Mach 1.6 at 40,000 ft. and 28,000 h.p. (about 5,000 lb.= 2,270 kg. s.t.) at Mach 3 at the same altitude.

The specific fuel consumption of such a power unit would decrease progressively between ground level and the tropopause, remaining constant above this height. At full thrust a specific fuel consumption of 2.5 lb./hr./lb. (2.5 kg./hr./kg.) would be expected at sea level, falling to 2.3 lb./hr./lb. (2.3 kg./hr./kg.) at the tropopause. At reduced thrust the figure would be 1.7 lb./hr./lb. (1.7 kg./hr./kg.) at sea level, reducing to 1.5 lb./hr./lb. (1.5 kg./hr./kg.) at the tropopause and greater heights.

At speeds of over Mach 2.5, the specific thrust and specific fuel consumption of the ramjet become superior to those of the turbojet. At the present time ramjets can be designed for speeds of up to Mach 4.5 and for continuous operation at altitudes up to 100,000 ft. (30,480 m.), though much higher altitudes can be reached outside the atmosphere by using kinetic energy gained within the atmosphere.

The Thor has an overall diameter of 15.75 in. (400 mm.) and a length (from the intake lip to the final nozzle) of 94.5 in. (2,400 mm.).

THE BRISTOL BRJ-801 RAMJET.

A ramjet designated BRJ-801, on the same lines as the Thor, but of much more advanced design, was shown at the 1957 S.B.A.C. Display. It has a diameter of 18 in. (455 mm.).

THE BRISTOL RAVEN.

The Raven is a solid-propellent rocket motor, built by Bristol Aircraft Ltd. (Weston Division) in collaboration with the Royal Aircraft Establishment, Westcott. It powers the Skylark research rocket of which details are given in the "Guided Missiles" section of this work.

The Raven is 18 ft. (5.49 m.) long and gives a thrust of 11,500 lb. (5,215 kg.) for about 30 sec.

DE HAVILLAND

THE DE HAVILLAND ENGINE COMPANY, LTD.

HEAD OFFICE: LEAVESDEN, HERTFORDSHIRE.

Directors: Sir Geoffrey de Havilland, C.B.E., A.F.C., F.R.Ae.S. (President); A. F. Burke, O.B.E., M.Inst.T., F.R.S.A. (Chairman); H. Buckingham (Managing Director); W. E. Nixon, F.C.I.S.; J. L. P. Brodie, M.I.A.E., M.I.Mech.E.; Dr. E. S. Moult, C.B.E., Ph.D., B.Sc.(Eng.), M.I.Mech.E., F.R.Ae.S.; and M. G. Ash (Financial Director).

The de Havilland Engine Co., Ltd., which is one of the three main operating subsidiaries in Great Britain of de Havilland Holdings, Ltd., entered the jet-propulsion field in the Spring of 1941. Design of the first D.H. jet engine—the H-1 or Goblin—began in April, 1941, and late versions of this engine continue in service in D.H. Vampire fighter and trainer aircraft.

The more powerful Ghost 48 is the power-unit of the D.H. Venom and Sea Venom fighters. In addition to its British production, the Ghost is being built under licence in Italy, Sweden and Switzerland.

Under development is the Gyron, de Havilland's first axial-flow turbojet engine, and a smaller version known as the Gyron Junior, two of which power the Blackburn N.A. 39 naval strike aircraft.

First de Havilland shaft-turbine engine will be the 1,000 h.p. Gnome. Announced in February, 1958, this will be a licence-built version of the T58 shaft-turbine developed by the American General Electric Company, with whom de Havilland have an agreement covering the exchange of technical information on all aspects of gas-turbine development.

In addition to its work on gas-turbines, the company has an establishment at Harlow engaged solely on rocket development. The Sprite introduced in 1949, was the first rocket motor for semi-permanent installation produced in the United Kingdom. It has now been superseded by the Super Sprite, which is available for use in both military or civil transport aircraft, and is being employed in the form of a jettisonable under-wing "pod" to assist the take-off of the Vickers Valiant bomber.

The later Spectre rocket powered the Saunders-Roe S-R.53 research aircraft, and is in production as an assisted take-off motor for the Avro Vulcan and Handley Page Victor bombers.

THE DE HAVILLAND GYRON JUNIOR.

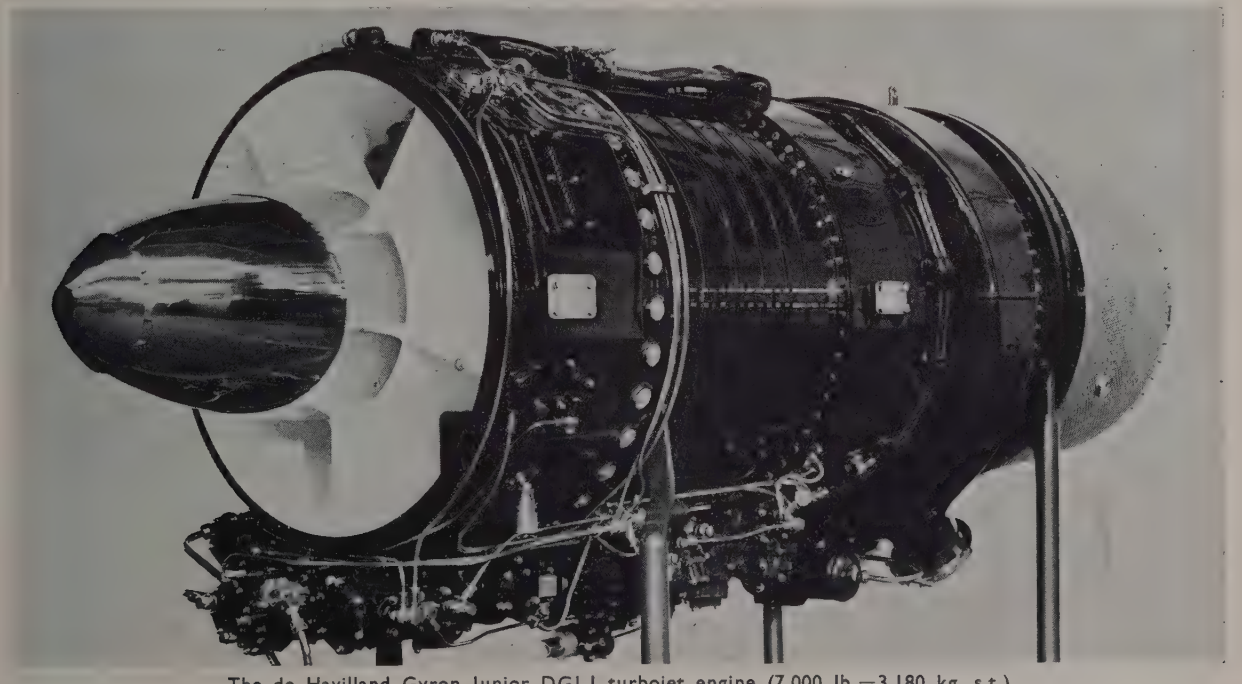
The Gyron Junior, which began test-bed running in the Summer of 1955, is a smaller version of the Gyron. This engine has been developed under a Ministry of Supply contract since September, 1954.

The Gyron Junior ran for the first time in August, 1955 and was shown publicly for the first time at the 1956 S.B.A.C. Display. No details were given, but a number of features were externally evident.

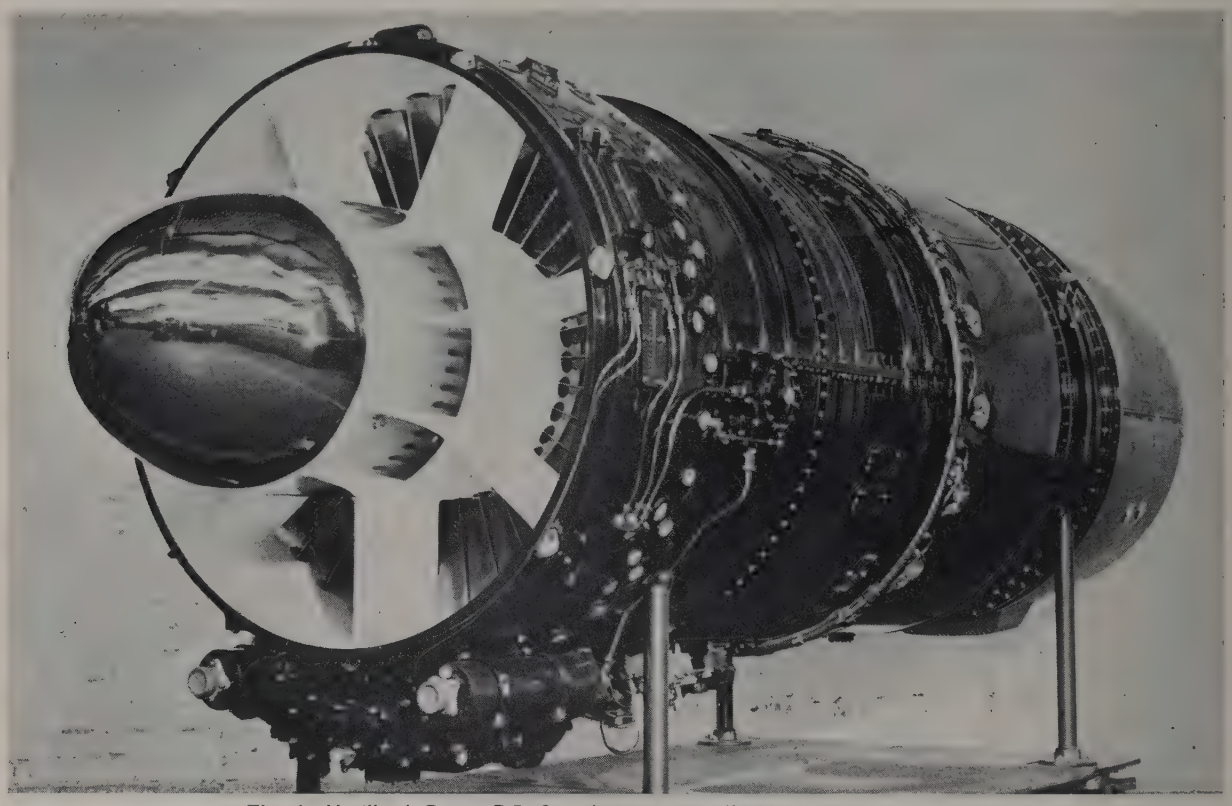
The air intake is a straightforward casting, forming an integral oil tank, and is de-iced by hot air bled from the compressor delivery manifold. Variable incidence guide vanes are fitted forward of the compressor which appears to have seven stages. Thirteen burners are provided in the cannular combustion chamber and a multi-stage turbine is used.

The first 150-hour test was run in September, 1956 and since then some thousands of hours of bench and flight-testing have been accumulated. First flight trials were in a modified Canberra in May, 1957, and two Gyron Juniors power the Blackburn and General Aircraft N.A. 39 naval strike fighter, the prototype of which flew for the first time on April 30, 1958.

During the Canberra programme, particular attention has been paid to testing the Gyron Junior under conditions whereby it supplies a proportion of its compressor air flow for aircraft flap-blowing and other aerodynamic high-lift



The de Havilland Gyron Junior DGJ.1 turbojet engine (7,000 lb.=3,180 kg. s.t.).



The de Havilland Gyron DGy.2 turbojet engine (20,000 lb.=9,072 kg. s.t.).

devices. This is made possible by the addition of an air-bleed manifold around the engine's combustion chamber.

Tests have included many hours of running with reheat, and flight trials of the Gyron Junior fitted with a reheat system were scheduled to begin in a specially-modified Gloster Javelin during 1958.

Reference may be made to three versions of the Gyron Junior :—

DGJ.1. Initial version, rated at 7,000 lb. (3,180 kg.) s.t. at sea level.

DGJ.2. More powerful development, first run in October, 1957.

DGJ.10. Considerably more powerful version announced in August, 1958. Appears to have 8 or 9 compressor stages, with one row of variable-incidence stator blades, and upstream burners. No air-bleed. Suitable for supersonic applications, with 40% afterburning when required. First run October, 1957.

DIMENSIONS (DGJ.1, approx.).—
Diameter 32 in. (813 mm.).
Length 88.5 in. (2,247 mm.).

THE DE HAVILLAND GYRON.

The Gyron axial-flow turbojet engine was designed specifically for flight at supersonic speeds.

Development began in 1950 and, except for a four-year period of official support was undertaken as a private venture.

The Gyron DGy.1 which ran for the first time on January 5, 1953, passed its 150 hour type-approval test at an initial thrust-rating of 15,000 lb. (6,810 kg.) in August, 1955. It began its air testing in the lower port engine nacelle of the Short Sperrin four-engined bomber on July 7, 1955.

On March 4, 1957, it was announced that the Gyron DGy.2 was then rated at 20,000 lb. (9,072 kg.) s.t. dry and 25,000 lb. (11,340 kg.) s.t. with reheat.

TYPE.—Axial-flow turbojet for use at high supersonic speeds.

AIR INTAKE.—Annular intake surrounding starter bullet. Both bullet and outer casing are double-walled for thermal de-icing. Air intake is a magnesium-zirconium alloy casting, the outer casing carrying the centre housing for the front main bearing *via* seven radial struts. In rear of intake casing are the hydraulically-operated variable-incidence compressor inlet guide vanes with actuator ring in rear face of centre housing.

COMPRESSOR.—Seven-stage axial type. Constant-diameter single-wall casing is split transversely and longitudinally, front pair of casings being machined from castings in R.R.58 aluminium-alloy and rear pair from castings in Samuel Fox Fortiweld high-tensile welding steel. Stator blades, machined from forgings in S.62 stainless steel, carried in dovetail grooves machined in casing. Rotating compressor assembly, using S.97 high tensile alloy steel throughout, consists of thin discs to carry the compressor blades and drums to join the adjacent discs. Blades, of S.62 stainless steel, secured to the discs by single gudgeon-pin-type swivel fittings which allow limited degree of tip rock in plane of rotation. First-stage rotor disc has integral stub shaft which runs in triple-race ball-bearing in rear of intake casing. Seventh-stage disc joined at its periphery to an eighth disc which carries the compressor rotor air seal and is attached to front periphery of main turbine shaft.

COMBUSTION CHAMBER.—Forward entry duct, fabricated of Fortiweld steel, comprises two concentric drums which form the diffuser outlet from compressor into the annular chamber, which contains a swirler plate assembly and inner and outer flame tubes of Nimonic 75. Seventeen Lucas Duplex burners with upstream injection.

FUEL SYSTEM.—Complete system supplied by Joseph Lucas (Gas Turbine Equipment) Ltd. Comprises two multi-plunger variable-delivery pumps, a proportional-flow control unit and flow distributor. Two high-energy igniter plugs.

NOZZLE GUIDE VANES.—Two stages of nozzle blades in inner and outer shroud rings. First-stage has hollow nozzle blades, formed of Nimonic 90 sheet seam-welded along trailing-edges, which fit into profiled slots in shroud rings and are secured by tie-rods. Second stage nozzle blades are machined from Nimonic 80A forgings and are pin-mounted through end tangs in inner and outer shroud rings. Air bled from compressor is fed through hollow first-stage nozzle blades to cool all nozzle and turbine blades.

TURBINE.—Two-stage. First stage disc located on main shaft by Hirth coupling, second stage disc is spigoted at its centre to rear of main shaft and attached to first stage by inter-stage drum with dowels. All blades, machined from Nimonic alloy forgings, retained in discs by fir-tree roots and pinned. Main shaft, which is attached at its front end to the eighth compressor disc, is supported at its rear end in a single roller main bearing on which the turbine is overhung, a series of spokes within the first stage nozzle blades providing radial support for the bearing housing.

JET PIPE.—Fixed type. Fabricated primarily in Nimonic 75 sheet.

AFTERBURNER.—Two designs developed, one short and one long for a specific aircraft application. No details.

ACCESSORY DRIVE.—Extension shaft from front of compresssor rotor provides drive through bevel gear-box and quill shaft to accessories mounted on underside of intake and compressor casing.

LUBRICATION.—Dry - sump type. Scavenge pump returns oil from sump to integral oil tank in annular intake casing.

OIL SPECIFICATION.—DERD. 2487.

MOUNTING.—Pick-up points on intake casing and front turbine shroud ring.

STARTING.—Either a 45 h.p. Rotax 110-volt D.C. electric starter or a D.H. hydrogen-peroxide turbo starter in nose bullet.

DIMENSIONS (D.Gy.1 and 2).—
Height 55.2 in. (1,402 mm.).
Width 49.9 in. (1,268 mm.).
Basic length 121.3 in. (3,081 mm.).
Length with exhaust cone assembly and propelling nozzle 155.5 in. (3,950 mm.).

WEIGHT DRY (D.Gy.1 and 2).—
4,200 lb. (1,900 kg.).

PERFORMANCE RATING (D.Gy.1).—
Max. static thrust 15,000 lb. (6,800 kg.) at sea level.

PERFORMANCE RATING (D.Gy.2).—
Max. static thrust 20,000 lb. (9,070 kg.) at sea level.

FUEL CONSUMPTION (D.Gy.1).—
At max. s.t. 0.95 lb./lb. s.t./hr. (0.95 kg./kg. s.t./hr.) at sea level.

FUEL CONSUMPTION (D.Gy.2).—
At max. s.t. 1.04 lb./lb. s.t./hr. (1.04 kg./kg. s.t./hr.) at sea level.

THE DE HAVILLAND GHOST.

Although larger than the Goblin, the Ghost has the same basic features and simple layout of the lower-powered engine, including a single-sided impeller, a single rigid rotor assembly, straight-through combustion, single-stage turbine and cantilever mounting.

The Ghost 48 has been built in two forms, the Marks 1 and 2, differing mainly in the fuel systems and in the fact that the Mk. 2 has provision for two generators with a correspondingly larger output.

A later variant is known as the Ghost 53 Mk. 1.

The Ghost powers the D.H. Venom, which in its Mk. 1 form flew the first time in September, 1949, and has been supplied to the Royal Air Force and the air forces of several foreign nations, and the Sea Venom which is in service in the Royal Navy, the Royal Australian Navy and the French Navy (as the Aquilon).

A full description of the Ghost has appeared in previous editions of "All the World's Aircraft."

DIMENSIONS.—
Max. diameter 53 in. (1,346 mm.).
Overall length to rear flange of exhaust cone 116 in. (2,946 mm.), standard exhaust cone being 51 in. (1.295 mm.) long to which is added 15 in. (38.1 cm.), for the propelling nozzle and cuff.

NET DRY WEIGHT (48 Mk. 1).—
2,145 lb. (973 kg.) ± 1¼%.

NET DRY WEIGHT (48 Mk. 2).—
2,230 lb. (1,011 kg.) ± 1¼%.

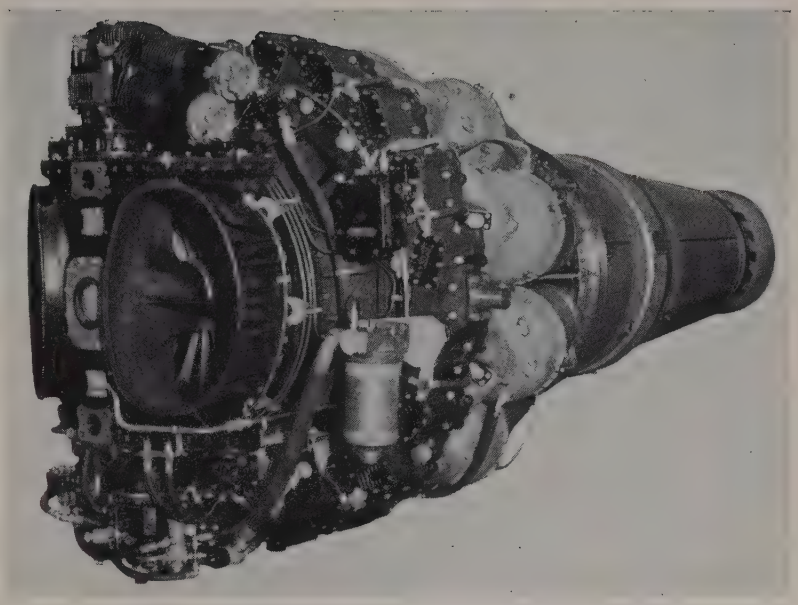
NET DRY WEIGHT (53 Mk. 1).—
2,179 lb. (988 kg.) ± 1¼%.

RATING (48 Mk. 1 and 2).—
Max. static thrust 4,850 lb. (2,200 kg.) at 10,250 r.p.m.

RATING (53 Mk. 1).—
Max. static thrust 5,300 lb. (2,405 kg.) at 10,350 r.p.m.

CONSUMPTION (48 Mk. 1 and 2 at max. static thrust).—
1.21 lb./lb. thrust/hr. (1.21 kg./kg. thrust/hr.) at sea level.

CONSUMPTIONS (53 Mk. 1 at max. static thrust).—
Fuel 1.19 lb./lb. thrust/hr. (1.19 kg./kg. thrust/hr.).
Oil 2.5 Imp. quarts/hr. (max.) (2.84 litres/hr.).



The de Havilland Ghost 48 Mk. 1 turbojet engine.

The Goblin was put into production to power D.H.'s first jet fighter, the D.H. 100 Vampire, the first prototype of which made its maiden flight on September 26, 1943.

The Goblin in its successively developed versions powered all versions of the Vampire with the exception of the experimental Mk. 4, the Australian-built Mk. 30 and the French licence-built Mk. 53 (Mistral), and to-day it powers the Vampire two-seat trainer which is in service in the Royal Air Force and the air forces of twenty nations.

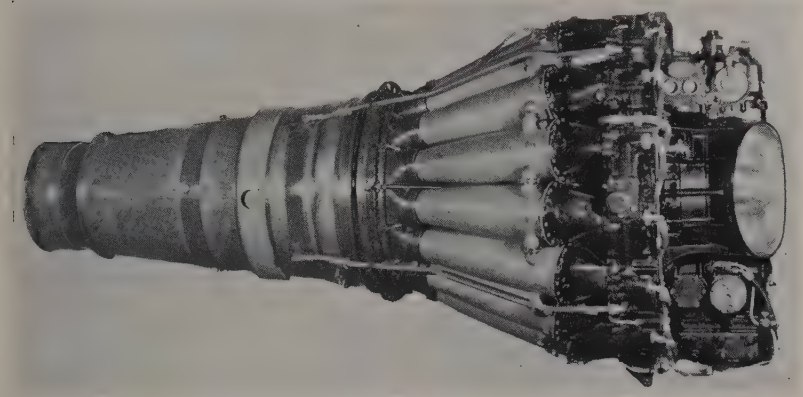
A full structural description of the Goblin has appeared in previous editions of "All the World's Aircraft."

DIMENSIONS.—
Max. diameter 49.85 in. (1,267 mm.).
Installed diameter (Vampire) 54 in. (1,370 mm.).
Length to rear flange of standard exhaust cone 100.5 in. (2,550 mm.).

NET DRY WEIGHT.—
1,629 lb. (739.5 kg.) + 2½%.

RATINGS.—
Max. static thrust 3,500 lb. (1,589 kg.) at 10,750 r.p.m.
Max. continuous 3,000 lb. (1,363 kg.) at 10,250 r.p.m.
Economical cruising 2,320 lb. (1,043 kg.) at 9,500 r.p.m.
Idling 155 lb. (70 kg.) at 3,000 r.p.m.

CONSUMPTION.—
Sea level static at 10,750 r.p.m. 1.16 lb./lb./hr. (1.16 kg./kg./hr.) at 9,500 r.p.m. 1.20 lb./lb./hr. (1.20 kg./kg./hr.).



The de Havilland Goblin 35 turbojet engine.

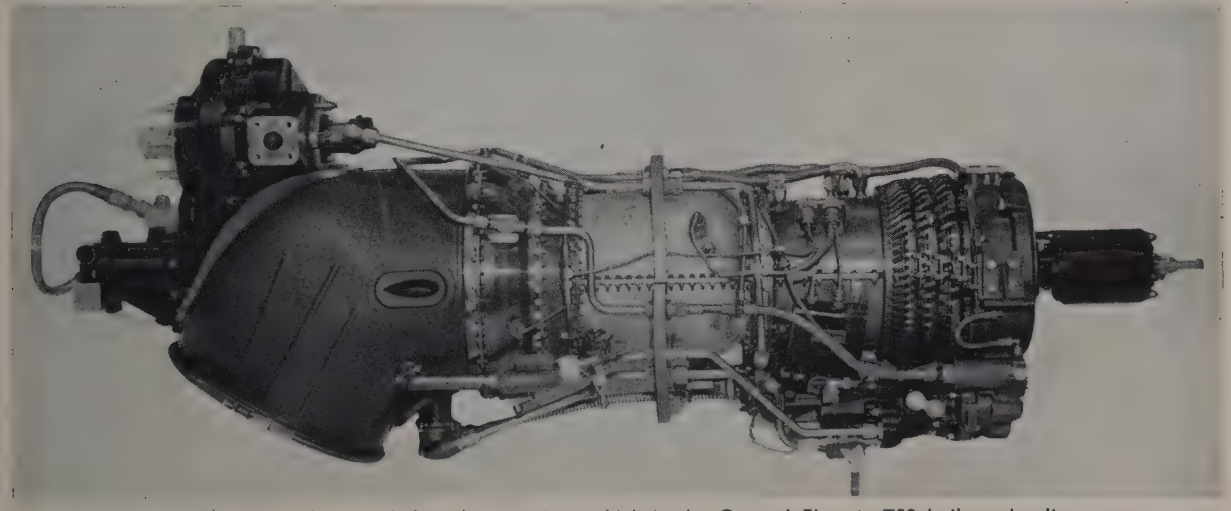
THE DE HAVILLAND GOBLIN.

The Goblin was D.H.'s first production turbojet engine. The original D.H. H.1 engine, later named the Goblin, powered the first of eight prototypes of the Gloster Meteor to fly on March 5, 1943.

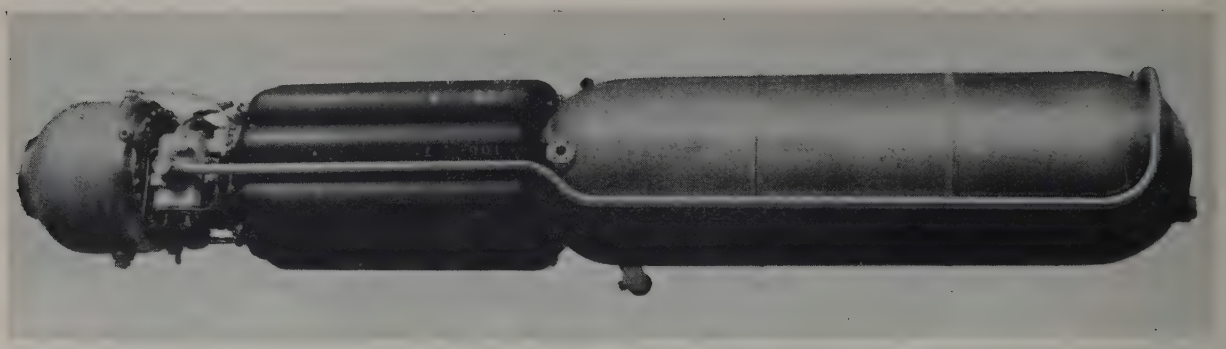
THE DE HAVILLAND GNOME.

Gnome is the name chosen for the version of the General Electric T58 shaft-turbine engine which de Havilland have the rights to manufacture in England. Initially, it is intended for use in helicopters, but later versions will be offered for turboprop installations.

A full description of the T58 appears under the "General Electric" heading in the United States section.



The de Havilland Gnome shaft-turbine engine, which is the General Electric T58 built under licence.



The de Havilland Super Sprite Liquid-propellent Rocket motor.

THE DE HAVILLAND SUPER SPRITE.

The Super Sprite is a development of the earlier Sprite and is a liquid fuel assisted take-off rocket motor which is intended for either permanent or jettisonable installation on military or transport aircraft. The Super Sprite employs hydrogen peroxide as the oxidant with kerosene or petrol injection to boost the rocket thrust either in magnitude or duration. A solid catalyst breaks down the hydrogen peroxide into gaseous steam and oxygen; this ensures a smokeless exhaust.

The Super Sprite produces a total impulse of 120,000 lb./sec. (54,430 kg./sec.) normally with a maximum thrust of 4,200 lb. (1,905 kg.) and a duration of 40 seconds, but both the maximum thrust and total duration can be altered within certain limits to suit different installations. Unlike rockets using solid propellents the Super Sprite can be shut down at any time during the firing by simply turning off a switch.

The propellents are contained in two separate tanks, the hydrogen peroxide of 80-85% concentration in a 57 gallon (259 litre) stainless steel tank situated in front of the motor, and the kerosene or wide-cut gasoline in a 5 gallon (23 litre) tank surrounding the propelling nozzle. The propellents are transferred to the combustion chamber by the pressure of nitrogen gas which is stored in nine bottles (total 3,690 cub. in.=60,470 cub. cm. capacity at 2,900-3,100 lb./sq. in.= 204-218 kg./cm.^{2}) surrounding the combustion chamber.

The cockpit controls consist only of two switches, one of which is a safety switch which prevents the accidental operation of the unit. Until both switches are closed the motor cannot be started.

Because the Super Sprite is self-contained, a jettisonable nacelle capable of being dropped from an aircraft, recovered and, after a minimum of servicing, reinstalled for the next take-off, has been developed. Its overall dimensions are approximately 150 in. long × 32 in. high ×28 in. wide (380 × 80 × 70 cm.) and its fuelled weight is about 1,900 lb. (860 kg.).

The nacelle is equipped with a parachute and parachute release-gear for the descent and a self-inflatable air-bag to cushion the impact of the nacelle with the ground. The parachute gear has been designed to give a rate of descent of 25 ft./sec. (7.6 m./sec.). The nacelle can be released from as low as 1,000 ft. (305 m.) and at speeds of up to 290 m.p.h. (465 km.h.).

First use of this Super Sprite jettisonable nacelle is to assist the take-off of the Vickers Valiant bomber.

The Super Sprite was the first British rocket engine to receive official type approval for quantity production and general service use.

DIMENSIONS.—
Overall diameter 20.5 in. (51.4 cm.).
Overall length 117.25 in. (297.8 cm.).

WEIGHTS.—
Dry 620 lb. (281.2 kg.).
Fuelled 1,460 lb. (662.2 kg.).

PERFORMANCE.—
Max. thrust 4,200 lb. (1,095 kg.).
Duration at max. thrust 40 sec.

THE DE HAVILLAND SPECTRE.

The Spectre is a liquid-propellent rocket motor which has been specifically designed for installation as part of the power-plant of interceptor fighters to enable them to achieve outstanding rate of climb and very high supersonic speeds, plus the ability to accelerate and manoeuvre at altitudes well above the limits set by the conventional air-breathing jet engine.

It is of the single-chamber type, providing a continuously-variable thrust output, and incorporates all pumps, valves and controls in one compact and light assembly suitable for ready installation in aircraft. The main cylindrical structure of the engine contains the turbine for driving the propellent pumps, the catalyst chamber and the combustion chamber. Ahead of this integral assembly is the gearbox, on which are mounted the centrifugal-type propellent pumps. The various control valves and associated linkage systems are located on the port side. Under the gearbox is the oil sump, and on the starboard side are the starter unit and fuel-cooled oil cooler. All the major components, valves and control units of the engine are of de Havilland design and manufacture.

The Spectre is designed to run on kerosene fuel, with high test peroxide (H.T.P.) as the oxidant. A small high-speed turbine, energized by a separate supply of H.T.P., is employed for driving the propellent pumps and the associated decomposition products from this unit are subsequently directed through the main combustion chamber.

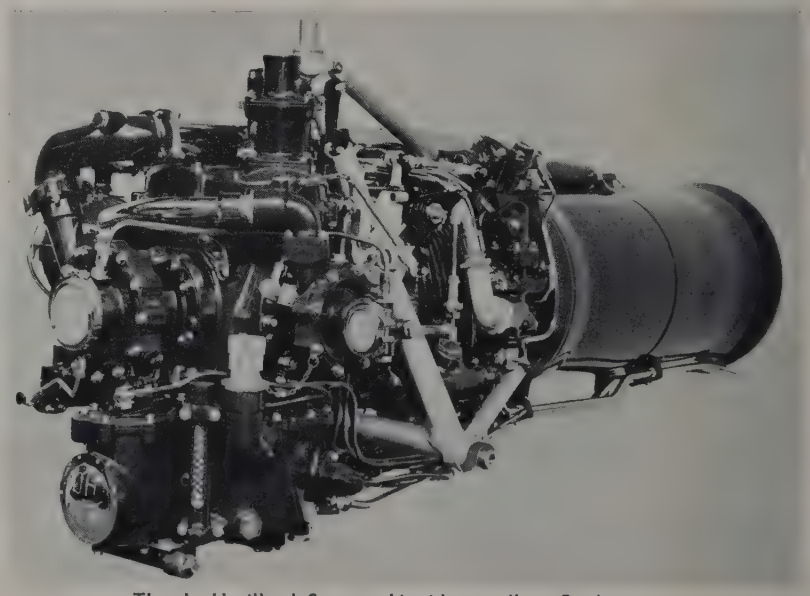
An important aspect of the functioning of the Spectre, is that the temperatures produced by chemically-correct combustion of an H.T.P.-kerosene mixture are as high as may be regarded practicable at present for use in long-life aircraft rocket engines. Thus the propellent combination provides the unique advantage that combustion at other than correct mixture ratios results in lower, rather than higher, gas temperatures. With imperfect mixing this implies the incurrence of "cold" spots on the combustion chamber wall as opposed to hot spots. A result of this characteristic is that an additional coolant liquid does not have to be employed to reduce the temperature of the combustion gases.

In the Spectre, the mixture ratio of H.T.P. to kerosene is in the region of 9 : 1 and the high flow of H.T.P. is able to be used to cool the chamber and nozzle before it is injected into the engine. This is known as regenerative cooling.

Packs of silver-plated gauze are provided in the catalyst chamber and the oxidant is decomposed on being passed through these. The fuel is then injected into the hot gaseous products of decomposition, so that exceptionally smooth thermal ignition of an inherently safe nature occurs. An added safety feature is that, during starting and shut-down, a purge of steam cleanses the combustion chamber and obviates the possibility of a dangerous accumulation of liquids.

The following versions of the Spectre have been announced:—

DSpe. 1. Initial version. First run "cold" on H.T.P. only, with water cooling, in July, 1953; and "hot," using H.T.P. and kerosene, in September, 1953. Completed Acceptance Test in October, 1953 and attained design rating in July, 1954. Water cooling was then discarded and the



The de Havilland Spectre Liquid-propellent Rocket motor.

DSpe. 1 completed a run of over one hour's continuous operation in October, 1954, using regenerative cooling.

DSpe. 2. Constant-thrust version of simplified design. Work on this version began in 1953 under government contract and the DSpe. 2 first ran in 1955. In production for assisted take-off applications.

DSpe. 3. Development of DSpe. 1. Variable-thrust.

DSpe. 4. Development of DSpe. 2. Constant-thrust. In production for assisted take-off applications.

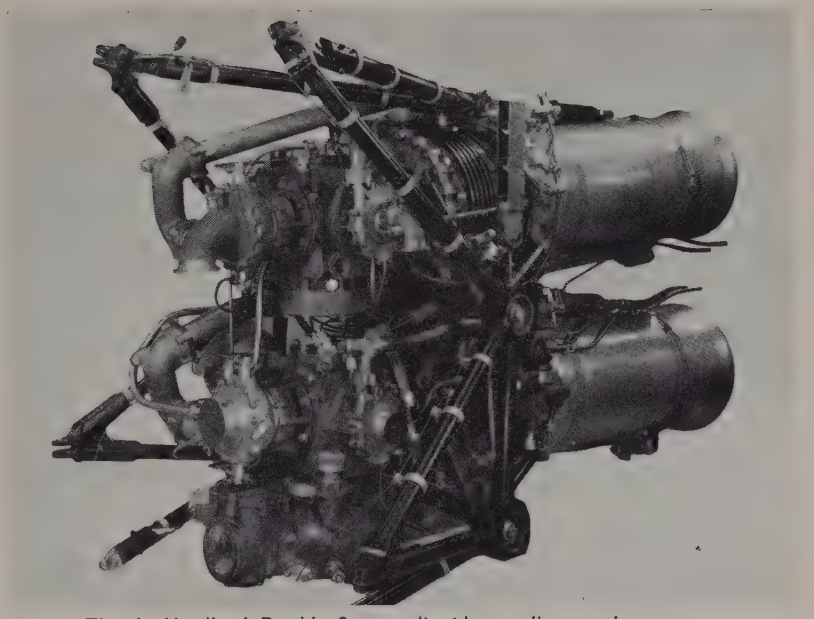
DSpe. 5. Development of DSpe. 1. Variable-thrust.

A Spectre is fitted in the Saunders-Roe S-R.53 research interceptor, and the engine is also being flight tested in the bomb-bay of a Canberra test-bed aircraft.

The DSpe. 2 and DSpe. 4 constant-thrust versions are in production as assisted take-off units for the Avro Vulcan and Handley Page Victor bombers. The installation will be similar to that of the de Havilland Super Sprite assisted take-off system already in use on the Vickers Valiant.

DIMENSIONS.—
Length 56.5 in. (1,435 mm.).
Max. diameter, excluding mounting, approx. 26.5 in. (673 mm.).
Max. diameter, including mounting, approx. 32.0 in. (813 mm.).

PERFORMANCE.—
No details available.



The de Havilland Double Spectre liquid-propellent rocket motor.

THE DE HAVILLAND DOUBLE SPECTRE.

The Double Spectre DSpe.D.1 comprises a fixed-thrust Spectre DSpe. 4 mounted above a variable-thrust Spectre DSpe. 5. It has been undergoing intensive development since the end of 1957 as a missile and piloted interceptor main propulsion unit, under Ministry of Supply contract. Several hundred runs have been made, involving both single and double firings. The Double Spectre may power the Avro stand-off bomb.

The upper and lower components are assentially independent and are mounted on a common tubular frame with only certain pipe-lines connecting them. The lower rocket is started first, the operation being initiated by nitrogen from a small pressure bottle on the starboard side of the engine. Propellents are H.T.P. and kerosene. No performance figures are available.

DIMENSIONS.—
Length overall 58.6 in. (1,490 mm.).
Max. height 37.5 in. (950 mm.).
Max. width 36.6 in. (930 mm.).

NAPIER

D. NAPIER & SON, LTD.

HEAD OFFICE: ACTON, LONDON, W.3.
WORKS: ACTON, LONDON, W.3., AND EAST LANCASHIRE ROAD, LIVERPOOL, 10.

Directors: Sir George H. Nelson (Chairman), P. Horsfall, H. G. Nelson, A.M.I.C.E., A.M.I.Mech.E., A.M.I.E.E., Air Vice-Marshal Sir Conrad Collier, K.C.B., H. Sammons, C.B.E., M.I.Mech.E., F.R.Ae.S. (Managing).

When the evolution of the gas-turbine engine foreshadowed the obsolescence of the piston engine the Napier Company, which is a member of the English Electric Group of companies, embarked on a programme of gas-turbine design and development.

Current Napier gas-turbine products are the Eland turboprop and the Gazelle free-turbine helicopter engine. Each of these is scheduled to power new British rotary-wing aircraft. The Eland has also been chosen to power the Canadair 540 version of the Convair-liner; and Napier have re-engined a Convair-340 and a Convair-440 with Elands to demonstrate to airlines the improved performance resulting from such conversions.

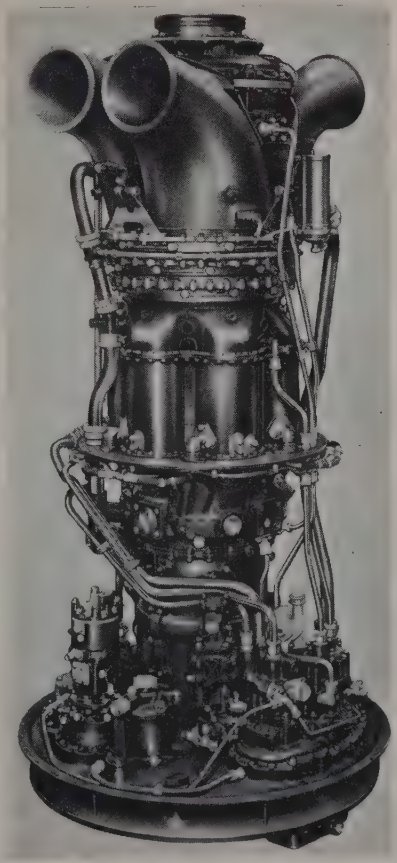
Gas-turbine research is undertaken in the company's research station at Liverpool; subsequent design and prototype construction take place in the headquarters works at Acton; and major production is centred in the Liverpool factory. Flight development and other work is done at Luton Airport, where Napier also conduct their rocket motor and ramjet activities.

A company named Napier Engines Inc. was formed in 1957, with headquarters in Washington, D.C., to handle the company's business interests in the U.S.A.

It was announced in March, 1957 that Napier and the Aerojet-General Corporation of America have concluded an agreement for the exchange of technical information on liquid-propellent rocket engines, in particular those using high test peroxide.

THE NAPIER GAZELLE.

The Gazelle is a free-turbine engine which has been designed primarily for helicopter applications and can be mounted in a horizontal, vertical or intermediate position, as required.



The Napier Gazelle.

Design of the Gazelle began in June, 1954 and the first unit ran on December 3, 1955, developing its full specified output of 1,260 h.p. on December 14, 1955. By mid-March, 1958, over 5,100 hours of testing had been completed, including 71 hours in flight.

Basically, the Gazelle comprises a multi-stage turbo-compressor unit, exhausting to a power-turbine which is mounted coaxially with, but mechanically independent of, the turbo-compressor unit. The final drive is taken through a reduction gearbox from the free power-turbine shaft, and the gases are exhausted to atmosphere through a bifurcated jet pipe. A torquemeter is incorporated in the reduction gearbox.

An interesting feature is that the six flame tubes have a common casing. Single-lever control is provided.

At the time of writing, the Gazelle had been chosen to power the Westland Wessex and Bristol Type 192 helicopters. Prototype engines had completed successfully their 25-hour flight approval tests and one Gazelle had completed three unofficial 150-hour runs, including 150 hours at full power and 900 accelerations, without being removed from the test bed, in June, 1957.

The following development stages of the design have been announced:—

Gazelle NGa.1. Initial version with emergency rating of 1,260 s.h.p.

Gazelle NGa.2. Emergency rating of 1,650 s.h.p. Specified for Bristol Type 192 twin-engined helicopter in which they will be installed at 7° from vertical.

Gazelle NGa.3. Emergency rating of 1,800 s.h.p.

Gazelle NGa.4. Emergency rating of 2,000 s.h.p.

Gazelle NGa.13. One-hour rating of 1,450 s.h.p. and maximum continuous rating of 1,200 s.h.p. New power-turbine giving opposite rotation to that in other versions, for use with standard Sikorsky transmission, gearbox and rotor in Westland Wessex helicopter, in which it will be installed at 35° to horizontal.

The following structural details apply specifically to the Gazelle NGa.1 :—

TYPE.—Free turbine Helicopter engine.

AIRSCREW DRIVE.—Epicyclic reduction gear with drive from free turbine. Ball and roller bearings. Ratio 6.0 : 1.

AIR INTAKE.—Radial type R.Z.5 magnesium zirconium alloy casting consisting of two discs joined by six radial struts, at bottom of engine. Anti-icing by hot engine oil circulated through five of the struts and underside of casting, and by hot air through sixth strut. Intake carries row of hollow variable-incidence guide vanes made of thin beryllium-copper sheet, heated by compressor-delivery air. Inlet air flow 16 lb. (7.25 kg.) per sec.

COMPRESSOR.—Eleven-stage axial-flow type at bottom of engine. Aluminium-bronze (DTD 197A) rotor blades secured by "fir-tree" roots to discs splined to shaft. Discs for stages 1, 8, 9, 10 and 11 of Rex 448 stainless steel, remainder of aluminium alloy. Shaft of S.106 stainless steel carried in roller and ball bearings. Two-piece casing cast in Z.T.1 magnesium-zirconium alloy, carrying aluminium-bronze (DTD 197A) stator blades mounted in rings bolted to casing. Compression ratio 6.37 : 1. Air mass flow 16 lb. (7.25 kg.) per sec.

COMBUSTION CHAMBERS.—Six tubular chambers made up of inner and outer flame tubes of Nimonic 75. Manufactured by Lucas. One Simplex upstream-injection burner in each chamber. Spark igniter plugs in two chambers.

FUEL SYSTEM.—Napier fuel metering unit with automatic compensation for variation in flight conditions. Lucas variable-stroke fuel pump.

FUEL GRADE.—DERD.2482, 2486 or 2488.

NOZZLE GUIDE VANES.—One row of fixed guide vanes of X.40 steel alloy for each turbine stage.

TURBINE.—Two independent axial turbines. Two-stage turbine drives compressor; single-stage turbine drives airscrew reduction gear mounted above it. Blades of compressor-turbine successively of Nimonic 100 and Nimonic 90. Blades of power-turbine of Nimonic 90. All blades attached by "fir-tree" roots to discs of Rex 448 stainless steel. Compressor-turbine discs splined to shaft of S.106 stainless steel. Power-turbine disc integral with extension shaft. Shafts carried in ball and roller bearings.

JET PIPE.—Fixed quadrupled jet pipes of Nimonic 75.

ACCESSORY DRIVES.—Through spur gears off lower end of compressor shaft in intake casing. Drive passes through one of radial struts to train of 13 gears on upper side of casing. Fuel pump, oil pumps, oil cooler fan, centrifugal breather and r.p.m. generator mounted above intake casing.

LUBRICATION SYSTEM.—Dry sump type, with gear-type pump. Normal oil supply pressure 80 lb./sq. in. (5.62 kg./cm.^{2}).

OIL SPECIFICATION.—DERD.2487.

MOUNTING.—Pads on main support plate between compressor and combustion chambers.

STARTING.—Rotax type EXP.4940 electric starter mounted adjacent to compressor. Provision for combustion or B.T.H. iso-propyl-nitrate starter when available.

DIMENSIONS.—
Max. diameter 33½ in. (850 mm.).
Overall length 70 in. (1,780 mm.).

WEIGHT DRY (NGa.1).—
780 lb. (354 kg.).

WEIGHT DRY (NGa.2).—
830 lb. (376 kg.).

WEIGHT DRY (NGa.3).—
865 lb. (392 kg.).

WEIGHT DRY (NGa.4).—
900 lb. (408 kg.).

PERFORMANCE (NGa.1).—
Emergency rating (2½ min.) 1,260 s.h.p. at 20,400 r.p.m.
One-hour rating 1,100 s.h.p. at 19,800 r.p.m.
Max. continuous rating 920 s.h.p. at 19,000 r.p.m.

PERFORMANCE (NGa.2).—
Emergency rating (2½ min.) 1,650 s.h.p. at 20,400 r.p.m.
One-hour rating 1,300 s.h.p. at 19,400 r.p.m.
Max. continuous rating 1,050 s.h.p. at 18,600 r.p.m.

PERFORMANCE (NGa.3).—
Emergency rating (2½ min.) 1,800 s.h.p. at 20,400 r.p.m.
One-hour rating 1,450 s.h.p. at 19,500 r.p.m.
Max. continuous rating 1,200 s.h.p. at 18,800 r.p.m.

PERFORMANCE (NGa.4).—
Emergency rating (2½ min.) 2,000 s.h.p. at 20,400 r.p.m.
One-hour rating 1,575 s.h.p. at 19,400 r.p.m.
Max. continuous rating 1,350 s.h.p. at 18,800 r.p.m.

FUEL CONSUMPTIONS (NGa.1).—
At emergency rating 0.708 lb. (0.321 kg.)/s.h.p./hr.
At one-hour rating 0.730 lb. (0.331 kg.)/s.h.p./hr.
At max. cont. rating 0.773 lb. (0.351 kg.)/s.h.p./hr.

FUEL CONSUMPTIONS (NGa.2).—
At emergency rating 0.676 lb. (0.307 kg.)/s.h.p./hr.
At one-hour rating 0.720 lb. (0.327 kg.)/s.h.p./hr.
At max. cont. rating 0.769 lb. (0.349 kg.)/s.h.p./hr.

FUEL CONSUMPTIONS (NGa.3).—
At emergency rating 0.664 lb. (0.301 kg.)/s.h.p./hr.
At one-hour rating 0.703 lb. (0.319 kg.)/s.h.p./hr.
At max. cont. rating 0.744 lb. (0.338 kg.)/s.h.p./hr.

FUEL CONSUMPTIONS (NGa.4).—
At emergency rating 0.635 lb. (0.288 kg.)/s.h.p./hr.
At one-hour rating 0.675 lb. (0.306 kg.)/s.h.p./hr.
At max. cont. rating 0.705 lb. (0.320 kg.)/s.h.p./hr.

OIL CONSUMPTION.—
Max. consumption 1 pint (0.57 litre)/hr.

THE NAPIER GAZELLE JUNIOR.

The Gazelle Junior is a smaller version of the Gazelle free-turbine engine. It is intended primarily for helicopter applications and will be offered also as a coupled engine for use in larger helicopters. A turboprop version is available, if required.

Like the Gazelle, this engine can be installed in any attitude from horizontal to vertical and can be arranged for either left-hand or right-hand rotation.

The Gazelle Junior has an axial-flow compressor driven by a two-stage axial-flow turbine. A single-stage power turbine is mounted co-axially with, but independently of, the turbo-compressor unit. The exhaust pipe is bifurcated, and the free power turbine shaft is located within the bifurcation.

Power from the free turbine is transmitted to the output shaft via an epicyclic reduction gear which incorporates a hydraulic torquemeter within its assembly.

Pressure and scavenge oil pumps, fuel pump, torquemeter pump and other engine accessories are grouped around the compressor and are driven by a separate gearbox from the compressor shaft. The drive to the accessories gearbox, which is also the drive from the starter, passes through one of the struts in the compressor intake. The engine is designed for any form of starting but, initially, provision is made for either electric or iso-propyl-nitrate starters.

For helicopter applications, the engine would normally be supplied with a Napier fuel metering unit, which not only provides single lever control, but also incorporates a number of safety devices. It provides automatic compensation for variations in flight conditions, and prevents surge during rapid accelerations. It also includes an engine overspeed control, a maximum turbine inlet temperature control and a maximum torque control.

If a failure should occur in the transmission system, a low positive signal from the torquemeter automatically shuts down the engine and prevents free turbine overspeed. If one engine of a twin-engine installation fails, the power of the working engine is automatically increased to a degree that will enable the pilot to maintain controlled flight. All the control and safety features have been satisfactorily developed on the Gazelle.

For turboprop applications of the new engine, equally comprehensive fuel metering, control and safeguard systems would normally be provided.

A drive is provided on the Gazelle Junior for a fan for oil cooling and for cooling and ventilating the engine bays. Protection of the engine air intake against icing can be provided, as can a spare drive from the accessories gearbox.

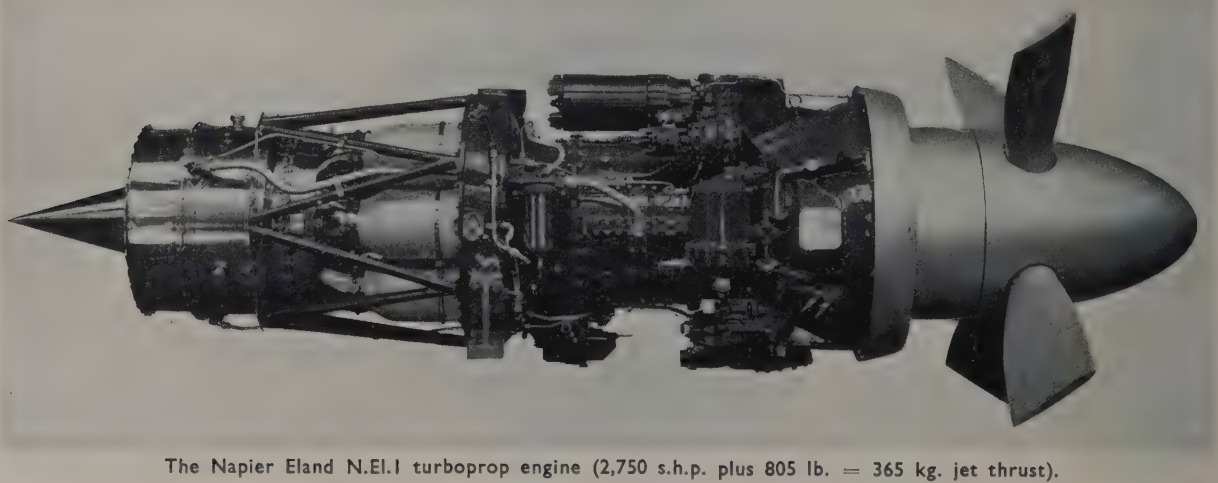
In the coupled installation each engine has an integral reduction gear of a lower ratio than that used in the single engine, an additional reduction being provided by a gearbox common to both engines.

The Gazelle Junior has been designed to run on any of the currently available aviation fuels.

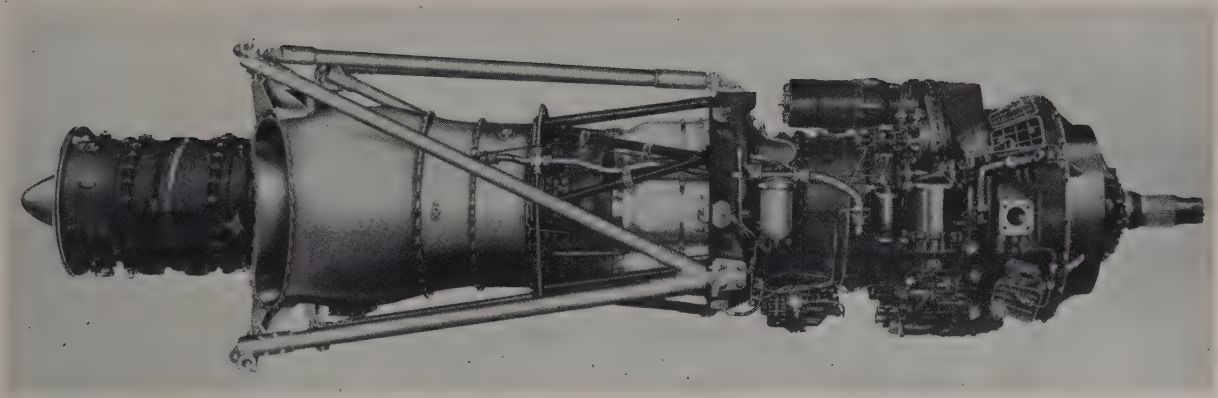
DIMENSIONS.—
Max. diameter 33.0 in. (838 mm.).
Length 54.0 in. (1,370 mm.).

WEIGHT.—
Dry 495 lb. (225 kg.).

PERFORMANCE (Stage 1).—
Max. rating 920 s.h.p.



The Napier Eland N.El.1 turboprop engine (2,750 s.h.p. plus 805 lb. = 365 kg. jet thrust).



The Napier Eland NEl.3 turboprop with auxiliary compressor. Two engines of this type power the Fairey Rotodyne prototype.

One-hour rating 765 s.h.p.
Max. continuous rating 680 s.h.p.

PERFORMANCE (Stage 2).—
Max. rating 1,070 s.h.p.
One-hour rating 900 s.h.p.
Max. continuous rating 800 s.h.p.

THE NAPIER ELAND.

The Eland is a small-diameter single-shaft turboprop engine of outstanding efficiency, with single-lever control. It first ran in 1952, was type-tested in 1956 and has been flight developed in Vickers Varsity, Airspeed Ambassador (Elizabethan) and Convair-340 and 440 aircraft. It will power the Canadair 540 version of the Convair-liner transport. The following versions have been announced :—

Eland NEl.1. Initial version with maximum take-off rating of 3,060 e.h.p.

Eland NEl.3. Adaptation of standard engine for helicopter application. Described separately on page 450.

Eland NEl.4. First of new family of Elands with air-cooled turbine-blading and higher temperatures. First run in April, 1955. Rated at 4,000 e.h.p.

Eland NEl.5. Development of NEl.4, dimensionally interchangeable with NEl.1 and 6. Further increase in compressor mass flow and compression ratio (8 : 1). Rated at 4,200 e.h.p.

Eland NEl.6. Basically similar to NEl.1, but with turbine blades of different material, permitting higher working temperatures, and increased mass flow. Rated at 3,500 e.h.p.

Eland NEl.7. This is an adaptation of the NEl.6 for helicopter application, with an auxiliary compressor added at the rear as on the NEl.3. It will power future versions of the Fairey Rotodyne aircraft. Described with the NEl.3 on page 450.

It was announced in March, 1958 that the Eland had passed a 150-hour Type Test for civil use under conditions laid down jointly by the British Air Registration Board and the U.S. Civil Aeronautics Administration at a sea-level take-off rating of 3,500 e.h.p. It has also passed a 150-hour military Type Test at the same rating.

Napier are offering Eland conversion kits to operators of Convair-Liner 340 and 440, Lockheed Constellation and certain other airliners, by which these aircraft can be converted easily to turboprop power.

The following constructional details apply specifically to the Eland NEl.1, except where otherwise stated :—

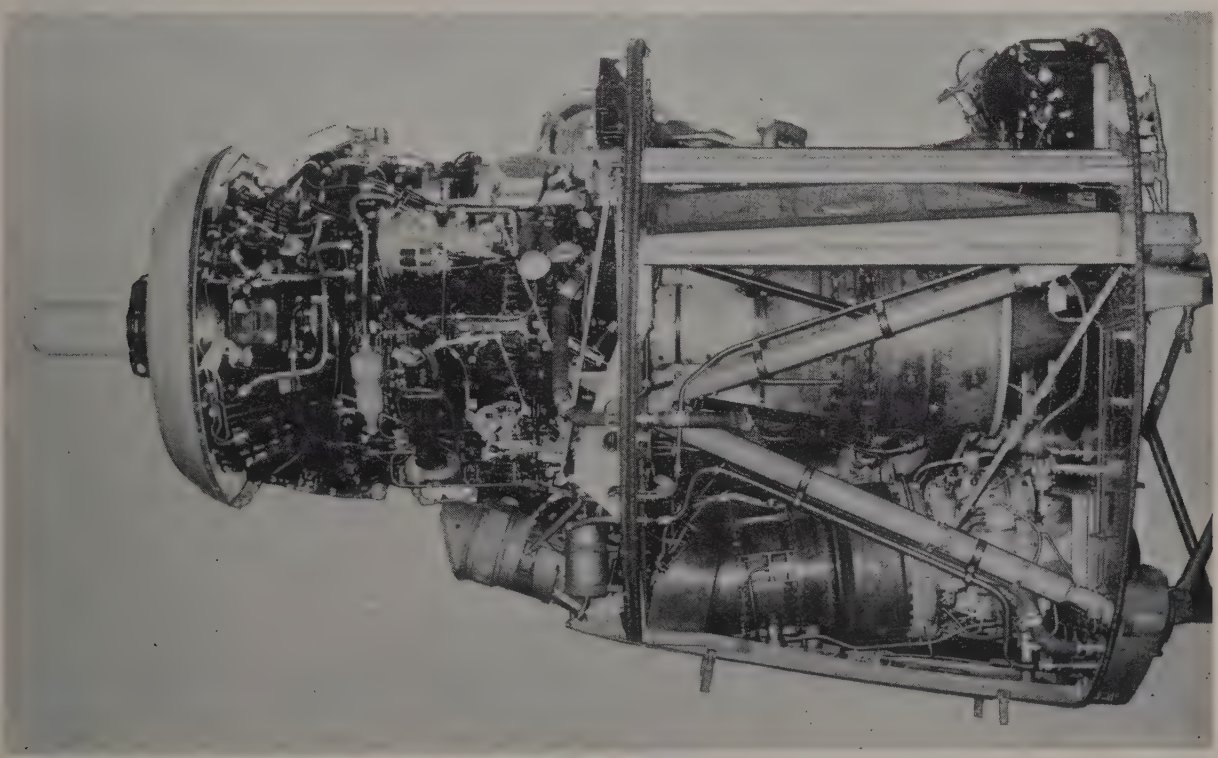
TYPE.—Turboprop engine with ten-stage axial compressor, six combustion chambers and three-stage turbine.

AIRSCREW DRIVE.—Compound epicyclic reduction gear, incorporating hydraulic torquemeter, driven from extension of compressor shaft. Following gear ratios can be provided : .0714, .0773, .0838 or .0912.

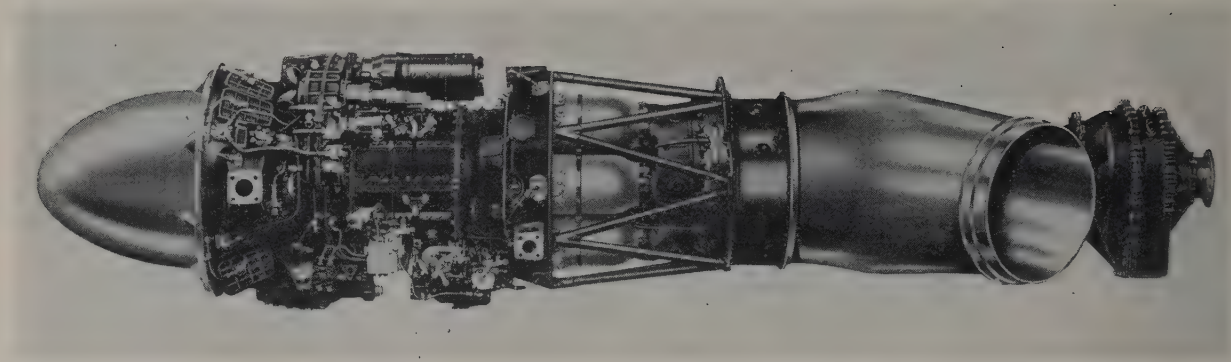
AIR INTAKE.—Annular forward facing intake surrounding reduction-gear casing immediately behind airscrew. Inner wall of intake anti-iced by reduction gear oil, outer wall by oil-heated jackets. Six spats in intake anti-iced by oil and variable-inlet guide vanes by air tapped from compressor.

COMPRESSOR.—Ten-stage axial compressor. Aluminium compressor casing cast in halves. Compressor shaft on ball and roller bearings at front and roller bearing at rear. Aluminium bronze blades throughout, the rotor blades being secured by "fir-tree" roots to aluminium and steel discs which, in turn, are splined to compressor shaft. First four stater stages of shrouded type, remainder of cantilever type. Compression ratio 7 : 1 (8 : 1 on NEl.5).

COMBUSTION CHAMBERS.—Six detachable tubular chambers. Outer casings of S.84 material, flame tubes in DTD.703. Upstream injection type burners. High energy spark ignition in two chambers. Chambers secured by clamping rings which, when released, permit each chamber to be withdrawn independently through turbine support frame.



The power-plant of the Canadair CL-66 which incorporates a Napier Eland NEl.6 and a Blackburn-Turbomeca Palouste air turbine starter.



The Napier Eland NEl.5 shaft-turbine, two of which power the Westland Westminster Utility helicopter.

FUEL SYSTEM.—Single-lever control operates an interconnected propeller governor and fuel metering unit, with automatic compensation for variations in altitude and forward speed, and embodies an acceleration control to ensure surge-free accelerations. This control is based on variable datum turbine inlet temperature control interconnected with engine speed. A hydraulic torquemeter in the reduction gear casing includes a reverse torque sensing device arranged to feather the propeller in event of engine failure.

FUEL GRADE.—Wide-cut gasoline (DERD. 2486) or Aviation turbofuel (DERD.2482).

TURBINE.—Three-stage axial-flow with air-cooled blades on NEl.4 and 5 versions. First stage nozzle blades cast in X40 material and are secured in inner and outer rings. Second and third stage nozzle blades, cast in same material with inner and outer platforms, are bolted to external turbine casing. First stage rotor blades are in Nimonic 90, second and third stages in Nimonic 80A. Rotor blades have "fir-tree" type root fittings. Turbine rotor discs, in H40 material, splined to shaft. Turbine shaft supported at front end by gear type coupling driving compressor, and at rear end by ball bearing.

JET PIPE.—Fixed nozzle type. Pipe and cone of Nimonic 75.

ACCESSORY DRIVES.—Accessories are mounted on reduction gear casing and are driven from front of compressor shaft. A splined shaft is provided for an aircraft accessory gear box and is situated above front end of compressor. Pressure oil pump, torquemeter pump and scavenge pumps are driven from a shaft at rear end of airscrew shaft and are mounted below engine. Fuel pump, tachometer and airscrew governor are driven from accessory gear-box drive and are mounted on top of engine.

LUBRICATION SYSTEM.—Pressurised jet feeds to bearings and gearing. Oil pressure and main scavenge pumps are of gear type, auxiliary scavenge pumps for compressor and turbine bearings are of vane type. All these components are manufactured by Napier. Normal oil pressure 80 lb./sq. in. (5.6 kg./cm.²).

OIL SPECIFICATION.—DERD.2487.

MOUNTING.— Single - plane type. Three mounting pads on support plate at rear of compressor.

STARTING.—Rotax electric starter, Type C.9401, mounted above front end of compressor casing, drives engine *via* accessory gear-box drive.

DIMENSIONS.—
Diameter $36\frac{1}{16}$ in. (91.6 cm.).
Length overall (from front end of airscrew shaft to turbine exit flange) $105\frac{1}{2}$ in. (267 cm.).
Frontal area 7.1 sq. ft. (0.66 m.²).

WEIGHT (NEl.1).—
Dry 1,575 lb. (715 kg.).
Complete with starter and governor 1,661 lb. (754 kg.).

WEIGHT (NEl.4 and 5).—
Dry 1,800 lb. (817 kg.) + $2\frac{1}{2}$%.

WEIGHT (NEl.6).—
Dry 1,750 lb. (794 kg.). + $2\frac{1}{2}$%.

PERFORMANCE (NEl.1 in S/L. Static I.C.A.N. conditions).—
Max. take-off 2,750 s.h.p., plus 805 lb. (365 kg.) net jet thrust at 12,500 r.p.m. (3,060 equivalent h.p.).
Max. continuous 2,070 s.h.p. plus 675 lb. (306 kg.) net jet thrust, at 12,000 r.p.m. (2,330 equivalent h.p.).
Typical cruising 1,665 s.h.p., plus 585 lb. (265.6 kg.) net jet thrust, at 11,500 r.p.m. (1,890 equivalent h.p.).

PERFORMANCE (NEl.4 in S/L. Static I.C.A.N. conditions).—
Max. take-off 3,765 s.h.p. plus 610 lb. (277 kg.) net thrust at 12,500 r.p.m. (4,000 equivalent h.p.).
Max. continuous 3,005 s.h.p. plus 515 lb. (234 kg.) net thrust at 12,000 r.p.m. (3,205 equivalent h.p.).

PERFORMANCE (NEl.5 in S/L. Static I.C.A.N. conditions).—
Max. take-off 3,765 s.h.p. plus 1,130 lb. (513 kg.) net jet thrust at 12,500 r.p.m. (4,200 equivalent h.p.).
Max. continuous 3,020 s.h.p. plus 940 lb. (426 kg.) net jet thrust at 12,000 r.p.m. (3,380 equivalent h.p.).
Typical cruising 2,470 s.h.p. plus 800 lb. (363 kg.) net jet thrust at 11,500 r.p.m. (2,780 equivalent h.p.).

PERFORMANCE (NEl.6 in S/L. Static I.C.A.N. conditions).—
Max. take-off 3,230 s.h.p. plus 700 lb. (318 kg.) net jet thrust at 12,500 r.p.m. (3,500 equivalent h.p.).
Max. continuous 2,670 s.h.p. plus 625 lb. (284 kg.) net jet thrust at 12,000 r.p.m. (2,910 equivalent h.p.).
Typical cruising 2,045 s.h.p. plus 615 lb. (279 kg.) net jet thrust at 11,500 r.p.m. (2,280 equivalent h.p.).

FUEL CONSUMPTIONS (NEl.1).—
At max. T.O. output 0.64 lb. (0.29 kg.) /e.h.p./hr.
At max. continuous output 0.68 lb. (0.31 kg./e.h.p./hr.

FUEL CONSUMPTION (NEl.4).—
At max. take-off output 0.560 lb. (0.25 kg.) per e.h.p./hr.
At max. continuous output 0.586 lb. (0.26 kg.) per e.h.p./hr.

FUEL CONSUMPTION (NEl.5).—
At max. take-off output 0.560 lb. (0.254 kg.) per e.h.p./hr..
At max. continuous output 0.580 lb. (0.263 kg.) per e.h.p./hr.
At typical cruising output 0.600 lb. (0.272 kg.) per e.h.p./hr.

FUEL CONSUMPTION (NEl.6).—
At max. take-off output 0.60 lb. (0.27 kg.). per e.h.p./hr.
At max. continuous output 0.615 lb. (0.279 kg.) per e.h.p./hr.
At typical cruising output 0.650 lb. (0.295 kg., per e.h.p./hr.

OIL CONSUMPTION.—
2 pints (1.1 litres) per hour.

THE NAPIER ELAND NEl.3 and NEl.7.

The Eland NEl.3 is an adaptation of the standard engine for helicopter application. It consists of an Eland turboprop engine with an auxiliary compressor mounted co-axially at the rear. This compressor when required is driven from the turbine *via* a hydraulic coupling.

Two Eland NEl.3 engines power each of the Fairey Rotodyne prototypes.

Future versions of the Rotodyne will have the similar, but more powerful NEl.7 engine, based on the NEl.6.

Design details of the NEl.3 are as for the NEl.1. Details of the additional components follow.

AUXILIARY COMPRESSOR.—Nine-stage axial-flow compressor with rearward-facing intake. Compressor rotor on ball bearing at inlet end and roller bearing at outlet. Aluminium-bronze blades used throughout. First three stator stages of shrouded type, remainder of cantilever type.

HYDRAULIC COUPLING.—Of traction type with two impellers driven from engine shaft and two runners on a common shaft driving auxiliary compressor. Oil for filling coupling supplied from main pressure line by means of separate booster pump, and this oil also used for cooling the coupling when not driving compressor.

JET PIPE.—Bifurcated type, each pipe with fixed nozzle.

LUBRICATION SYSTEM.—Pressure jet feeds to bearings and gearing. All pumps of gear type and manufactured by Napier. Main oil pressure 80 lb./sq. in. (5.625 kg./cm.²).

MOUNTING.—A frame bolted to pads on main support plate forms the engine mounting structure and is bolted direct to aircraft bulkhead mounting fitments.

DIMENSIONS (NEl.3).—
Diameter 36.0625 in. (91.6 cm.).
Length (from front of airscrew shaft to auxiliary compressor inlet flange) 158.25 in. (402 cm.).
Frontal area 7.1 sq. ft. (0.65 m.²).

WEIGHT DRY (NEl.3).—
Including engine mounting frame but without final jet pipes 2,525 lb. (1,145 kg.) + $2\frac{1}{2}$%.

PERFORMANCE (NEl.3, S/L Static I.C.A.N. conditions).—
Max. take-off 2,805 s.h.p. plus 500 lb. (227 kg.) net thrust at 12,500 r.p.m. (3,000 equivalent h.p.).
One hour rating 2,500 s.h.p. plus 480 lb. (218 kg.) net thrust at 12,500 r.p.m. (2,685 equivalent h.p.).
Max. continuous 2,180 s.h.p. plus 420 lb. (191 kg.) net thrust at 12,000 r.p.m. (2,340 equivalent h.p.).

PERFORMANCE (NEl.7).—
Max. take-off 3,250 s.h.p. plus 650 lb. (295 kg.) net thrust at 12,500 r.p.m. (3,500 equivalent h.p.).
One-hour rating 2,900 s.h.p. plus 625 lb. (284 kg.) net thrust at 12,500 r.p.m. (3,140 equivalent h.p.).
Max. continuous 2,600 s.h.p. plus 550 lb. (250 kg.) net thrust at 12,000 r.p.m. (2,810 equivalent h.p.).

FUEL CONSUMPTIONS (NEl.3).—
At max. take-off output 0.625 lb. (0.28 kg.) per e.h.p./hr.
At one-hour rating output 0.644 lb. (0.29 kg.) per e.h.p./hr.
At max. continuous output 0.663 lb. (0.30 kg.) per e.h.p./hr.

FUEL CONSUMPTIONS (NEl.7).—
At max. take-off output 0.605 lb. (0.275 kg.) per e.h.p./hr.
At one-hour rating output 0.625 lb. (0.28 kg.) per e.h.p./hr.
At max. continuous output 0.630 lb. (0.286 kg.) per e.h.p./hr.

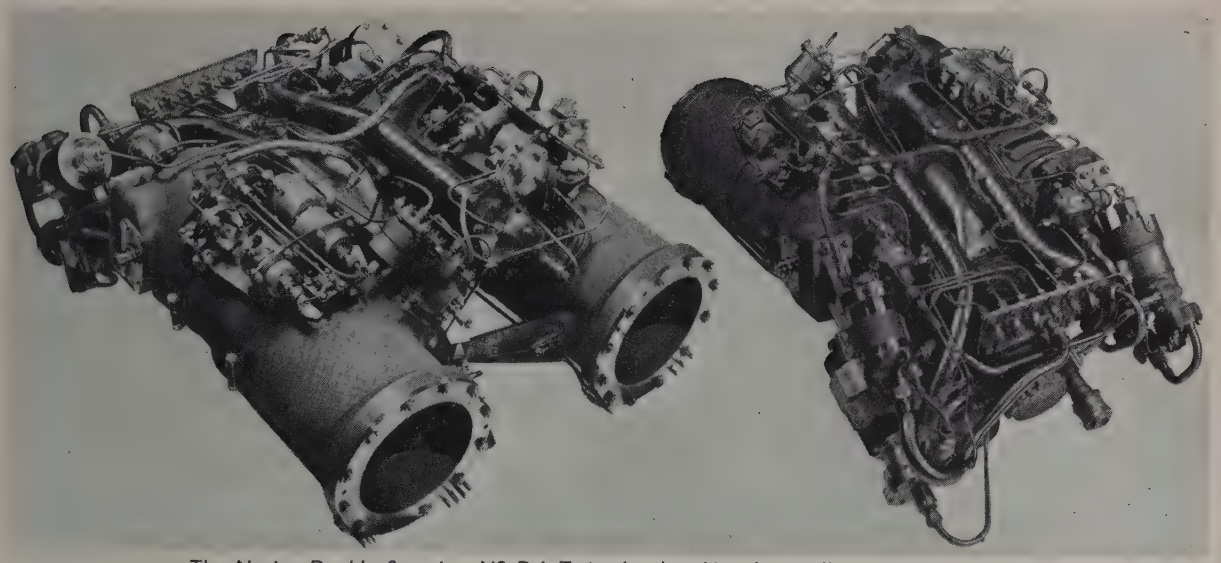
OIL CONSUMPTION (NEl.3).—
2 pints (1.1 litres) per hour.

THE NAPIER N.R.E.17 ROCKET.

Two versions of the N.R.E.17 liquid-propellent rocket engine were shown at the 1955 S.B.A.C. Display. The first had a regeneratively-cooled chamber machined from steel forgings, with the fuel feed entering at the throat. The other, probably in production form, was a sheet steel structure. Intended for missile applications, the N.R.E.17 develops approximately 2,000 lb. (907 kg.) s.t., running on hydrogen peroxide and kerosene.

THE NAPIER N.R.E. 19 ROCKET.

First shown at the 1956 S.B.A.C. Display, the N.R.E. 19 is one of a series of miniature rocket motors designed for rotor-tip application to increase the rate-of-climb of helicopters. It was demonstrated on the rotor of a Saunders-Roe



The Napier Double Scorpion NScD.1 Twin-chamber Liquid-propellent Rocket motor.

Skeeter, being supplied from a tank of high test peroxide propellent mounted above the rotor hub. Weight of the complete system (dry) was stated to be under 30 lb. (13.6 kg.).

The N.R.E. 19 consists of a catalyst cylinder and rocket outlet weighing just over 1 lb. (0.45 kg.) and giving 22-25 lb. (10-11.35 kg.) s.t. for a consumption of 1 Imp. gallon (4.55 litres) of fuel each minute.

THE NAPIER N.R.J. 1 RAMJET.

The N.R.J. 1 ramjet was produced for the National Gas Turbine Establishment in the form of a ramjet test vehicle (RJTV) used to obtain data on fuel system and combustion performance. It has a pitot-type intake giving a single normal shock. The RJTV is 20 ft. (6.10 m.) long and has a diameter of approximately 18 in. (460 mm.).

It was announced on January 23, 1958 that a Napier ramjet test vehicle had flown under power to a height of 70,000 ft. (21,335 m.) in 40 sec. It was accelerated to speed by eight solid-propellent boosters and in the course of its flight reached a speed of Mach 2.3. When its fuel was exhausted at 70,000 ft. it coasted to a height of 114,000 ft. (34,750 m.).

THE NAPIER DOUBLE SCORPION.

Designed and developed at the Napier Flight Development Establishment at Luton, the Double Scorpion NSc.D1-2 is a twin-chambered liquid-propellent (high test peroxide and kerosene) rocket engine which made its first ground runs on May 19, 1956. An initial air firing took place the following day, with the Scorpion mounted inside the bomb-bay of a modified Canberra aircraft.

The two combustion chambers are of equal size and can be mounted either side-by-side or one above the other. Each chamber is regeneratively-cooled by the full oxidant flow. Ignition is initiated and sustained by passing the oxidant through a catalyst element which decomposes the H.T.P. into superheated steam and free oxygen. The high temperature and pressure produced in the combustion chambers by this reaction spontaneously ignite the kerosene fuel, a principle known as "thermal ignition."

A small high-pressure turbine, driven by H.T.P. steam generated from an auxiliary catalyst unit, drives two centrifugal pumps which supply the main H.T.P. flow and the kerosene to the combustion chambers. Electric solenoid control valves regulate the propellents during the starting sequence and enable each chamber to be fired independently if desired. The ability to make repeated start-stop sequences at any altitude is one of this engine's most outstanding features.

The Double Scorpion was instrumental in breaking the World's Altitude Record for manned aeroplanes in August, 1957. Installed in an English Electric Canberra B.2 aircraft, this rocket engine raised the aircraft from a cruising altitude of 44,000 ft. (13,400 m.) attained with its two Rolls-Royce Avon turbojets, to 70,310 ft. (21,430 m.).

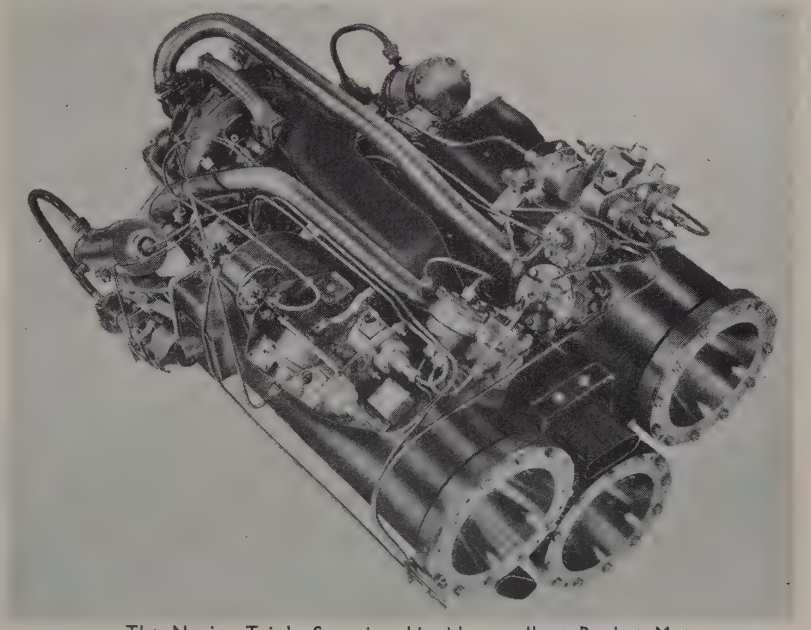
The NScD.1-2 is now in production as an auxiliary power unit for the English Electric P.1B high-altitude interceptor.

DIMENSIONS (side-by-side chambers).—
Length 34.0 in. (863 mm.).
Width 23.0 in. (584 mm.).
Height 15.0 in. (381 mm.).

WEIGHT.—
Dry 216 lb. (98 kg.).

THE NAPIER TRIPLE SCORPION.

First shown at the 1958 S.B.A.C. Display, the Triple Scorpion NSc.T.1 has a third chamber mounted cloverleaf fashion under the twin chambers of a Double Scorpion. No details are available.



The Napier Triple Scorpion Liquid-propellent Rocket Motor.

ROLLS-ROYCE

ROLLS-ROYCE, LIMITED.

HEAD OFFICE: DERBY.

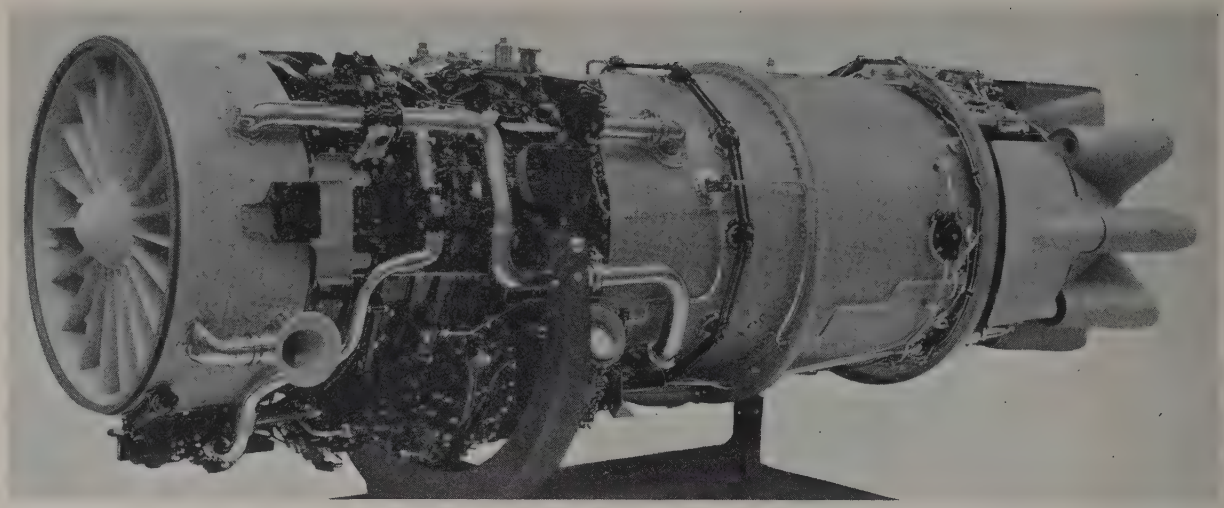
WORKS: DERBY, CREWE AND GLASGOW.

LONDON OFFICE: 14-15, CONDUIT STREET, W.1.

Established: March 15, 1906.

Directors: Lord Kindersley, C.B.E., M.C. (Chairman); J. D. Pearson, J.P., B.Sc.(Eng.), Wh.Sc., M.I.Mech.E., A.F.R.Ae.S., M.I.P.E. (Chief Executive, Deputy Chairman and Managing Director, Aero Engine Division); Whitney W. Straight, C.B.E., M.C., D.F.C. (Deputy Chairman); Harold Peake, M.A.; W. T. Gill, C.A. (Financial Director); Dr. F. Llewellyn Smith, M.Sc., D.Phil. (Managing Director, Motor Car Division); W. A. Robotham (Managing Director, Oil Engine Division); A. A. Rubbra, B.Sc. (Technical Director); A. F. Kelley, B.Sc. (General Manager, Aero-Engine Division); F. T. Hinkley, B.Sc., M.I. Mech.E. (General Manager, Sales and Service); A. A. Lombard, F.R.Ae.S. (Chief Engineer, Aero-Engine Division); J. L. E. Smith, M.A.

At the end of 1941, under instructions from the Ministry of Aircraft Production,



The Rolls-Royce Conway RCo.10 (16,500 lb.=7,485 kg. s.t.) with integral noise suppressor and thrust reverser.

Rolls-Royce undertook the development and manufacture of the Whittle-type engine in conjunction with Power Jets, Ltd. and the Rover Company.

The first Rolls-Royce version of the Whittle W2B/23 jet-propulsion engine passed its 100-hour type test in April, 1943, and was named the Welland. It was thus the first of the long series of Rolls-Royce gas-turbine engines to be named after English rivers, these names being chosen to give the idea of flow associated with jet-propulsion.

Production deliveries of the Welland began in May, 1944, to power the Gloster Meteor twin-jet fighter, later versions of which were fitted with Rolls-Royce's second turbojet, the Derwent.

The Nene, a parallel development of the Derwent which it resembles in general features and layout, was first run in October, 1944, and has been built in large numbers in Australia, France and the United States, as well as by Rolls-Royce. From it was developed the Tay which has also been built in quantity by Pratt & Whitney in the U.S.A. and Hispano-Suiza in France.

The Avon engine, the first Rolls-Royce axial-flow engine to go into production, is being manufactured by the Rolls-Royce group of factories in the United Kingdom, and under licence in Australia, Belgium and Sweden.

Also in production is the Dart turboprop engine, which powers the Vickers Viscount, the World's first turboprop-powered airliner now in airline service on six continents; the Fokker F-27, which is also being built under licence in the U.S.A. by Fairchild; the Handley Page Herald; the Armstrong Whitworth A.W. 650 Argosy; and the Grumman Gulfstream.

The Conway by-pass turbojet is in production for the Handley Page Victor B Mk. 2, and for the Boeing 707-420 and Douglas DC-8 airliners.

Under current development are advanced versions of the Avon for military and civil use, the Dart and the Conway. The company is also developing the Tyne turboprop for the Vickers Vanguard and the Canadair CL-44, and the RB.108 turbojet for VTO applications. The RB.141 by-pass turbojet chosen for the D.H. 121 is in the early design stages.

In addition, Rolls-Royce continues to carry out development on re-heat and on thrust-reversers and noise-suppression units for the Avon and Conway.

The company has signed a licence agreement with North American Aviation, Inc., under which it will manufacture and develop high-thrust rocket-motors using techniques evolved originally by the U.S. company.

In partnership with Vickers and Foster Wheeler, Rolls-Royce formed a new company known as Vickers Nuclear Engineering, Ltd. early in 1956. Previously, it had been announced that Rolls-Royce is working on the development of lightweight nuclear reactors for propulsion, and that these activities are centered in a nuclear engineering laboratory near Derby.

Rolls-Royce will provide the reactor for H.M.S. *Dreadnought*, the first British atomic-powered submarine. The Rolls-Royce-designed reactor Neptune is in operation at Harwell.

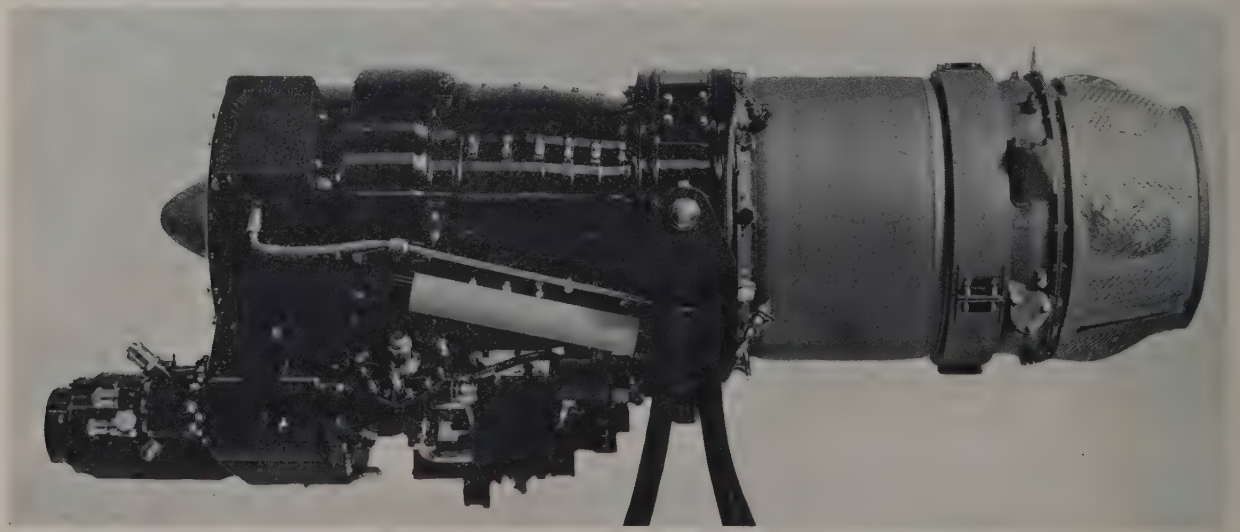
THE ROLLS-ROYCE CONWAY.

The Conway is an axial-flow engine of the "by-pass" type. The "by-pass" engine resembles the normal twin-spool jet engine but has an additional duct through which some of the air from the low-pressure compressor by-passes the high-pressure compressor and combustion chambers and re-enters the jet stream aft of the turbine.

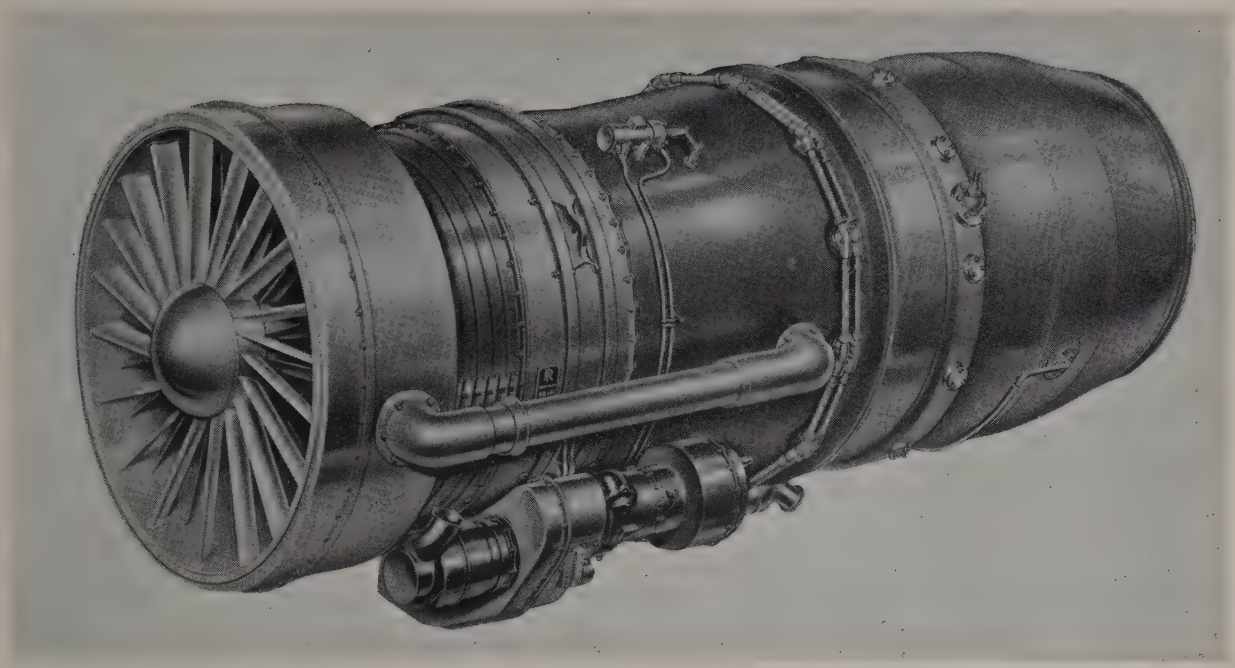
The advantage of this type of engine over the straight-through jet is that although the by-pass engine works at a high temperature and pressure ratio, giving high internal efficiency, it also produces by means of the by-pass a final jet containing a greater mass of air moving at a lower speed, which gives a higher propulsive efficiency. The result of this arrangement is to improve the specific fuel consumption. Compared with a straight turbojet of the same thrust, the "by-pass" engine is lighter.

The lower jet velocity in conjunction with the latest form of Rolls-Royce noise-suppression unit reduces jet noise. Fire protection is assisted by the duct of cool air which surrounds the hot part of the engine.

These qualities make the Conway particularly suitable for large long-range civil



The Rolls-Royce RB.145 lightweight turbojet engine (2,750 lb.=1,250 kg. s.t.).



The Rolls-Royce RB.141 by-pass turbojet engine which has been selected to power the Airco D.H. 121.

airliners, and it has been specified for versions of the Boeing 707 and Douglas DC-8 transports, as well as for the Vickers VC10 airliner. It also has obvious military applications, combining fuel economy with tremendous power when fitted with an afterburner, and four Conways will power the Handley Page Victor B. Mk. 2 bomber.

No constructional details of the Conway may be published, but it is known to have multi-stage low-pressure and high-pressure compressors, an annular combustion chamber with 10 Duplex burners, and two sets of mechanically independent turbine stages. Versions so far announced are the RCo.2 (9,250 lb.=4,196 kg. s.t.), the RCo.3 (11,500 lb.=5,217 kg. s.t.), the RCo.5 which completed a type test at 13,000 lb. (5,897 kg.) s.t. with the lowest specific fuel consumption of any turbojet yet tested, the RCo.7 (13,000 lb.= 5,897 kg. s.t.) and the RCo.11, which has been type-tested in accordance with the U.S./U.K. civil type test schedule at 17,250 lb. (7,830 kg.) s.t. dry. The version for the Boeing 707-420 and the Douglas DC-8 is the RCo.10, rated at 16,500 lb. (7,485 kg.) s.t.

Other versions of which brief mention can be made are the RCo.12 (17,500 lb.= 7,945 kg. s.t.), RCo.14 (17,500 lb.= 7,945 kg. s.t.), and the RCo.15 (18,500 lb.=8,400 kg. s.t.). The figures given are those for guaranteed minimum thrust.

Dimensions (RCo.10).—
Length 132.45 in. (3,365 mm.).
Diameter 42 in. (1,065 mm.).

THE ROLLS-ROYCE RB.145.

The RB.145 is a lightweight turbojet engine, based on the RB.108 and giving 2,750 lb. (1,250 kg.) s.t. It has a very high power to weight ratio and is suitable for a wide range of aircraft applications.

The RB.145 appears to have a seven-stage axial-flow compressor and single-stage turbine. It has at least one zero-stage of compression and drives considerably more accessories than the RB. 108. An external oil tank is mounted on the front casing. There is a hot-air anti-icing system and starting is by two air-impingement jets.

THE ROLLS-ROYCE RB.141

Chosen to power the D.H. 121 jet transport, the RB.141 is a by-pass turbojet of advanced design and has an initial rating of 12,000 lb. (5,445 kg.) s.t. It will have a specific fuel consumption and a noise level without suppressors much lower than any existing engine of comparable thrust; and is suitable for military applications.

THE ROLLS-ROYCE RB.108.

It was announced in November, 1955 that Rolls-Royce was developing a new gas-turbine engine under the designation of RB.108. This has a type-test rating of 2,010 lb. (912.5 kg. s.t.).

Five RB.108's are installed in the Short SC.1 experimental VTO aircraft.

No details of the RB.108 were available for publication at the time of writing.

THE ROLLS-ROYCE AVON.

The Avon axial-flow turbojet was developed after the war to replace the Nene. It has been in large-scale production both in the United Kingdom and overseas for many years and powers a very large number of military and civil types.

The 100-Series Avons have a 12-stage compressor and eight individual combustion chambers. The later 200-Series engines are of almost entirely new design with higher pressure ratio compressors, annular combustion chambers and considerably higher power. Both series are in production.

THE AVON 100 SERIES.

The following are the principal versions of the 100 Series :—

RA.3. First Avon to be type-tested and the first to go into production. Type-test rating 6,500 lb.=2,950 kg. s.t. Into production in June, 1950.

RA.7. Basic S/L. s.t. rating 7,500 lb. (3,402 kg.). Type-tested in March, 1952. Thermal anti-icing. Seven versions of RA.7 rating engine put into production. First deliveries to aircraft manufacturers in September, 1952. Built under licence in Australia, Belgium and Sweden.

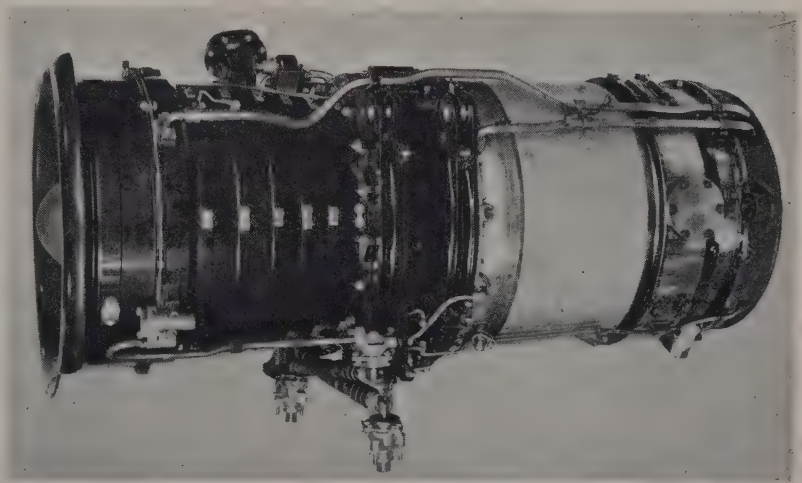
RA.7R. RA.7 with re-heat. Type-tested in January, 1953 at 9,450 lb. (4,290 kg.) S/L. static thrust with re-heat. Variable-area jet-pipe nozzle.

RA.21. Production development of RA.7 type up-rated to 8,000 lb. (3,628 kg.) s.t. Compression ratio 6.4 : 1. Air mass flow 124 lb./sec. (56 kg./sec.).

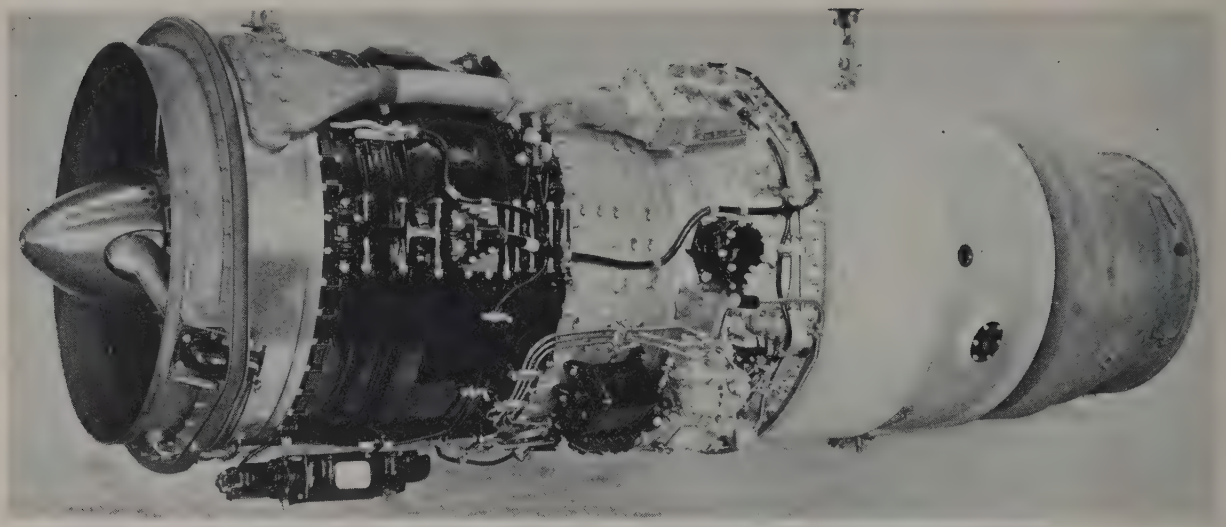
The following details apply to the RA.7 engine :

Type.—Axial-flow turbojet.

Air Intake.—Annular type surrounding starter bullet. Provision for thermal (hot air) de-icing. Inlet air flow 120 lb./sec. (54 kg./sec.).



The Rolls-Royce RB.108 (2,010 lb.=912.5 kg. s.t.).



The Rolls-Royce Avon RA.24 military turbojet engine (11,250 lb.=5,103 kg. s.t.).

COMPRESSOR.—Twelve-stage axial-flow. Rotor blades secured by pins to the rotor discs which are splined on to shaft. First eight rows of discs and blades of forged RR.58 aluminium alloy. Last four rows have discs forged from S.62 steel and blades of D.T.D. 197-type aluminium bronze. First seven rows of stator blades made from RR.58 aluminium alloy, next four rows from D.T.D. 197-type aluminium bronze, and last row (carried by outlet casing) of precision cast H.R. Crown Max steel. Stator blades secured in grooves in upper and lower halves of RR.250 aluminium alloy compressor casing. Total of 1,018 rotor blades and 1,195 stator blades. First four rows of stator blades shrouded. Compressor shaft carried on front roller bearing and rear ball bearing. Compression ratio 6.5 : 1. Air mass flow 120 lb./sec. (54 kg./sec.).

COMBUSTION CHAMBER.—Eight interconnected straight-flow type made from Nimonic 75 alloy. Duple fuel atomizers at forward end of combustion chambers. High-energy type ignition with plugs in Nos. 3 and 6 chambers.

FUEL SYSTEM.—Low-pressure system with Lucas Twin-D pump and barometric control unit.

FUEL GRADE.—DERD.2482 and 2486.

NOZZLE GUIDE VANES.—Sixty-seven low-pressure vanes of special Rolls-Royce heat-resisting steel. Seventy-six high-pressure vanes of H.R. Crown Max steel.

TURBINE.—Two-stage axial turbine with 71 Nimonic 95 blades on low-pressure stage and 103 Nimonic 90 blades on high-pressure stage. All blades shrouded at tips. Blades secured by "fir-tree" roots to turbine discs which are splined to shaft. Roller bearing forward of disc assembly. Gas temperature after turbine 700°C.

JET PIPE.—Fixed type on RA.7; variable type on RA.7R with reheat. D.T.D.571 steel jet pipe and inner cone. Max. jet pipe temperature 1,256°F. (679°C.).

ACCESSORY DRIVE.—Off port side of wheelcase to auxiliary gearbox on port side.

LUBRICATION SYSTEM.—Closed circuit pressure type, using Rolls-Royce pumps. Sump combined with tank and mounted on flange below compressor outlet casing. Oil capacity 2 Imp. gallons (9 litres). Oil supply pressure 15 lb./sq. in. (1.05 kg./cm.²).

OIL SPECIFICATION.—D.E.R.D.2487.

MOUNTING.—Main trunnions on each side of nozzle box ahead of turbine. Forward mounting framework at compressor casing.

STARTING.—B.T.H. triple-breech cartridge starter in centre of air intake. Alternatively liquid-fuel starter or Rotax electric starter.

DIMENSIONS, WEIGHTS AND PERFORMANCE.—See table.

THE AVON 200 SERIES.

The 200 Series Avon is virtually a completely new engine. A new compressor with additional stages is used while a "cannular" combustion system in which the eight flame tubes are enclosed in an annular chamber replaces the individual combustion chamber system of the earlier Series.

The following are the engines so far announced in the 200 Series :—

RA.14. First of the 200 Series with high-pressure ratio compressor and annular combustion chamber. Type-tested in April, 1953, at a thrust of 9,500 lb. (4,310 kg.) without re-heat. This engine was the forerunner of the RA.26 and RA.28 engines of 10,000 lb.=4,540 kg. s.t. The RA.14 never went into production but the RA.28 did in both fighter and bomber versions.

RA.24. Military engine. Passed type test at a rating of 11,250 lb. (5,103 kg.) s.t. in July, 1956. Also RA.24R with reheat. In production.

RA.26 (Mk. 521). Civil version of RA.28. 10,000 lb. (4,540 kg.) s.t. Weight 2,790 lb. (1,267 kg.). Powers the Sud Aviation Caravelle prototypes.

RA.28. Military engine. First Avon to be type-tested at 10,000 lb. (4,540 kg.) s.t.

RA.29. Civil engine rated at 10,500 lb. (4,767 kg.) s.t. Differs from the RA.28 by having an additional zero compression stage and a three-stage turbine. In production for the D.H. Comet 4 and the Sud Caravelle. Granted full Normal Category approval by the A.R.B. for civil use after being type-tested in accordance with the combined U.K./U.S. civil type test schedule. Authorised by the A.R.B. to enter service with an overhaul life of 1,000 hours, the first civil jet to achieve this distinction before actually going into airline service. Later versions of the RA.29 will give 11,700 lb. (5,310 kg.) and 13,300 lb. (6,035 kg.) s.t.

A special version of the Avon RA.28 with modified lubrication and fuel systems for vertical running was developed for the Ryan X-13 experimental VTO aircraft.

Series 200 engines are in production for the English Electric P.1B, D.H. Sea Vixen, Supermarine Scimitar, Hawker Hunter Mk. 6, English Electric Canberra P.R.9, and also power the Vickers Valiant. The 200 Series Avon is also being built under licence in Belgium by the Fabrique Nationale d'Armes de Guerre (FN) and in Sweden by Svenska Flygmotor AB.

The following details apply to the RA.28 engine :—

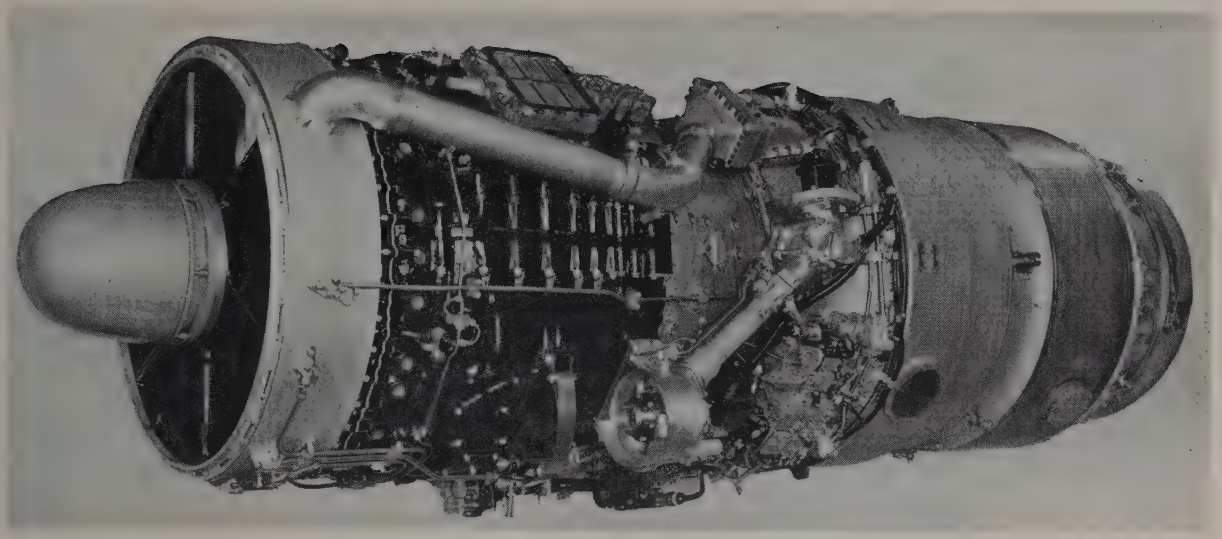
TYPE.—Axial-flow turbojet.

AIR INTAKE.—Annular casing surrounding starter bullet. Variable-incidence inlet guide vanes, of DTD.171 weldable chrome-nickel austenitic steel, automatically-operated by hydraulic ram. Magnesium intake casing incorporates front bearing housing to which is bolted the starter reduction gear housing. All forward-facing surfaces have compressor bleed anti-icing.

COMPRESSOR.—Fifteen-stage axial flow. Rotor blades pinned to rotor discs which are splined to shaft. Discs of Rex 448 or Jessops H 46 stainless steel. Rotor and matching stator blades of aluminium alloy (stages 1-8), stainless steel (stages 9-11) and titanium alloy (stages 12-15). First four stages of stator blades are tip-shrouded. Compressor shaft, on two bearings, one roller (front) and one ball (rear), in two parts with flanged joint forming part of 15th stage disc. Compressor casing



The Rolls-Royce Avon RA.24R turbojet engine with reheat, two of which power the English Electric P.1B Lightning.



The Rolls-Royce Avon RA.29 turbojet engine (10,500 lb.=4,767 kg. s.t.).

in two parts, the forward casing, of cast magnesium, covering first seven compressor stages and rear casing of aluminium alloy. Cast compressor outlet casing directs air into eight ducts, hollow webs between each duct collecting hot compressor air for anti-icing and cabin pressurisation.

Combustion Chamber.—Eight flame tubes mounted within annular chamber, each fitted with Rolls-Royce duplex burner. Interconnecting pipes between each pair of flame tubes. High-energy igniters in Nos. 3 and 6 tubes. Flame tubes of Nimonic 75. Double-walled combustion system casing of Fortiweld steel.

Fuel System.—Differs from 100 Series Avons in that it is controlled by variations of flow rather than variations of pressure. Proportion of main engine flow is fed from upstream of the throttle valve and by-passed to the pump outlet. This forms the proportional circuit which controls main flow under varying conditions of altitude, jet-pipe temperature and engine speed.

Nozzle Guide Vanes.—Nozzle casing, of cast chrome steel, has two rows of guide vanes, one ahead of each turbine stage. All vanes of C.242 steel.

Turbine.—Two-stage. Turbine shaft coupled to compressor shaft by ball and socket coupling with splined sleeve to transmit torque and supported at rear end by roller bearing. High-pressure blades of Nimonic 95A, low pressure blades of Nimonic 80A, secured to steel discs by "fir-tree" roots and locked. All blades shrouded at tips.

Jet Pipe.—Of Nimonic 75, flange-bolted to nozzle casing. Exhaust cone carried on four faired radial struts. Insulating material in space between two walls of outer casing.

Accessory Drives.—Horizontal shaft drive to each side of engine from gear system, driven by main shaft from just aft of centre bearing. External wheel case on starboard side serves lubrication and fuel pump systems, drive on port side serves, through bevel drive, generators or alternators or ancilliary gear-box mounted on airframe.

Lubrication System.—Closed circuit system with combined oil tank and sump under compressor casing and fuel-cooled oil cooler on port side. Lubrication of three main bearings, starter reduction gear and ancilliary drive system by single pump. Five pumps scavenge bearings and drives.

Starting.—By electric starter motor or iso-propyl gas starter or kerosene/air turbojet, all mounted in bullet in air intake.

Dimensions, Weights and Performance.—See Table.

THE ROLLS-ROYCE TYNE.

The Rolls-Royce Tyne is an advanced twin-spool high-compression turboprop engine. It will power the Vickers Vanguard and the Canadair CL-44. The Tyne first ran in April, 1955, and began its flight testing in the Summer of 1956 in the nose of an Avro Lincoln flying test-bed. Two Airspeed Ambassadors are being fitted with Tynes so as to obtain increased flying experience.

Few details of the construction of the Tyne have been published, but it is known to have a multi-stage low-pressure compressor driven by a three-stage low-pressure turbine, a multi-stage high-pressure compressor driven by a single-stage high-pressure turbine and an annular combustion chamber. The high-pressure turbine incorporates air-cooled turbine blades. Compression ratio is 13 : 1.

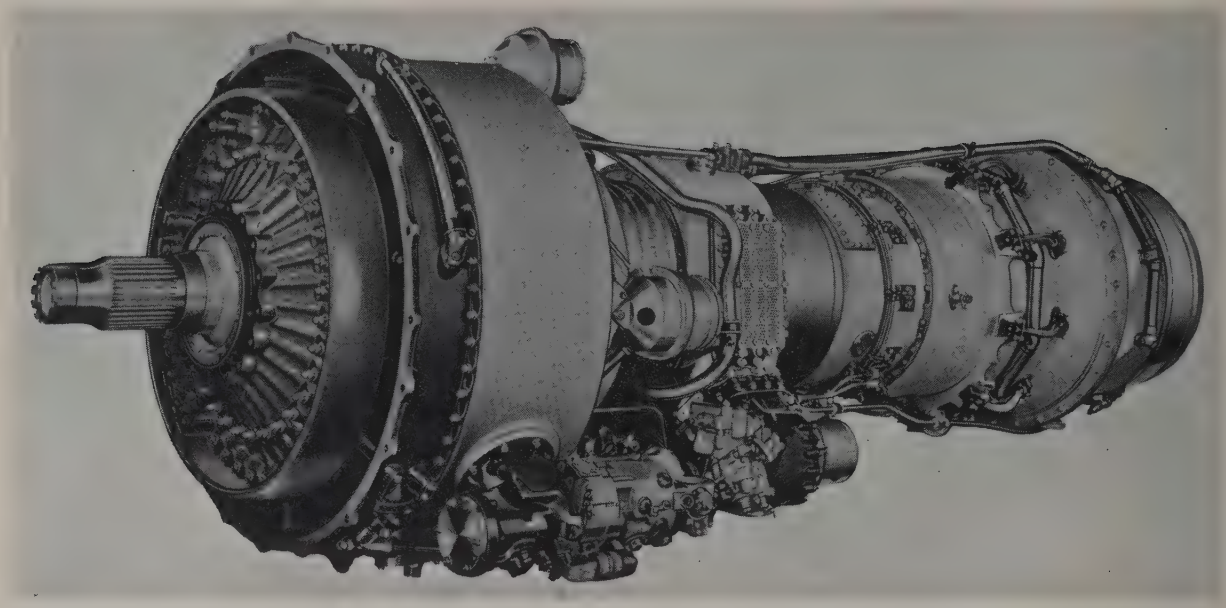
Overall size has been kept remarkably low by careful design. The compressors are of very small diameter and most of the accessories are packed below the compressor casing. The air intake casing houses an integral oil tank and compound-epicyclic reduction gearing for the airscrew which has a diameter of 14 ft. 6 in. (4.42 m.). Reduction gear ratio for the Vanguard will be 0.064 : 1.

RTy.1. Rated at 4,500 b.h.p. (4,985 e.h.p.) for take-off and with 2,455 b.h.p. (2,685 e.h.p.) available for cruising at 425 m.p.h. (685 km.h.) at 25,000 ft. (7,620 m.). Cruising specific fuel consumption 0.405 lb. (0.184 kg.) per e.h.p./hr.

RTy.11. Rated at 5,030 b.h.p. (5,525 e.h.p.) for take-off and with 2,845 b.h.p. (3,195 e.h.p.) available for cruising at 425 m.p.h. (685 km.h.) at 25,000 ft.

ROLLS-ROYCE AVON AXIAL-FLOW TURBOJET ENGINES.

Type	Thrust (Basic S/L. rating)	Specific Fuel Consumption (max. T.O. conditions)	Net Dry Weight (approx.)	Power/Weight Ratio	Length (without jet pipe)	Diameter
RA.3	6,500 lb. (2,950 kg.)	0.88 lb./hr./lb. (0.88 kg./hr./kg.)	2,240 lb. (1,016 kg.)	2.90 lb. s.t./lb. (2.90 kg. s.t./kg.)	102.1 in. (2,593 mm.)	42.225 in. (1,072 mm.)
RA.7	7,500 lb. (3,402 kg.) at 7,950 r.p.m.	0.92 lb./hr./lb. (0.92 kg./hr./kg.)	2,460 lb. (1,116 kg.)	3.05 lb. s.t./lb. (3.05 kg. s.t./kg.)	102.1 in. (2,593 mm.)	42.225 in. (1,072 mm.)
RA.7R	9,500 lb. (4,310 kg.) (with reheat) at 7,950 r.p.m.	1.90 lb./hr./lb. (1.90 kg./hr./kg.) (with reheat)	2,960 lb. (1,343 kg.) (with reheat jet pipe)	3.20 lb. s.t./lb. (3.20 kg. s.t./kg.)	120 in. (3,048 mm.)	42.225 in. (1,072 mm.)
RA.14	9,500 lb. (4,310 kg.)	0.84 lb./hr./lb. (0.84 kg./hr./kg.)	2,860 lb. (1,297 kg.)	3.32 lb. s.t./lb. (3.32 kg. s.t./kg.)	113.3 in. (2,877 mm.)	41.5 in. (1,054 mm.)
RA.21	8,000 lb. (3,628 kg.) at 8,100 r.p.m.	0.925 lb./hr./lb. (0.925 kg./hr./kg.)	2,520 lb. (1,143 kg.)	3.17 lb. s.t./lb. (3.17 kg. s.t./kg.)	102.1 in. (2,593 mm.)	42.225 in. (1,072 mm.)
RA.24	11,250 lb. (5,103 kg.)	—	—	—	117.5 in. (2,985 mm.)	42 in. (1,067 mm.)
RA.26 (Civil)	10,000 lb. (4,540 kg.)	0.86 lb./hr./lb. (0.86 kg./hr./kg.)	2,790 lb. (1,265 kg.)	3.58 lb. s.t./lb. (3.58 kg. s.t./kg.)	113.3 in. (2,877 mm.)	41.5 in. (1,054 mm.)
RA.28	10,000 lb. (4,540 kg.)	0.86 lb./hr./lb. (0.86 kg./hr./kg.)	2,890 lb. (1,311 kg.)	3.46 lb. s.t./lb. (3.46 kg. s.t./kg.)	113.3 in. (2,877 mm.)	41.5 in. (1,054 mm.)
RA.29 (Civil)	10,500 lb. (4,767 kg.)	0.775 lb./hr./lb. (0.775 kg./hr./kg.)	3,341 lb. (1,517 kg.)	3.14 lb. s.t./lb. (3.14 kg. s.t./kg.)	113.3 in. (2,877 mm.)	42 in. (1,067 mm.)



The 4,985 e.h.p. Rolls-Royce Tyne RTy.1 turboprop engine.

(7,620 m.). Cruising specific fuel consumption 0.388 lb. (0.176 kg.) per e.h.p./hr.

RTy.12. Rated at 5,090 s.h.p. plus 1,075 lb. (488 kg.) s.t. For Canadair CL-44D.

DIMENSIONS.—
Overall diameter 40.5 in. (1,030 mm.).
Length 100.25 in. (2,545 mm.).

WEIGHT (RTy.1).—
Dry weight 2,023 lb. (918 kg.).

THE ROLLS-ROYCE DART.

Although the design of the Dart began in 1945 the engine has been continuously developed to meet the requirements of civil operators. Originally the Dart produced 1,000 e.h.p., but this has been steadily increased so that the current production engines are rated at 2,100 e.h.p. Further development incorporating advanced features such as air-cooled turbine blading will raise the power to 2,660 e.h.p.

The following are the production versions of the Dart :—

Mk. 505 (RDa.3). First production model. Reduction gear 0.106 : 1. Mass air flow 20 lb./sec. Shrouded turbine blades. Powered early 700 Series Viscounts.

Mk. 506 (RDa.3). As 505 but with various refinements to compressor and turbine blading which give reduced working temperature and better specific fuel consumption. Additional 80-90 s.h.p. under cruise conditions. Powers later 700 Series Viscounts.

Mk. 510 (RDa.6). Reduction gear 0.093 : 1. As 506 but with strengthened reduction-gear, multiple seals on H.P. and L.P. turbine blade shrouds, etc. Powers 700D and early 800 Series Viscounts. RDa.6 with three-stage turbine developed for Breguet 1050 Alizé anti-submarine aircraft in production for French Navy.

Mk. 511 (RDa.6). Reduction gear 0.086 : 1. As 510 but for Fokker F.27 11 ft. 6 in. (3.50 m.) diameter airscrew.

Mk. 520 (RDa.7). Reduction gear 0.093 : 1. Ten per cent increased mass air flow (22 lb./sec.), increased capacity compressor, three-stage turbine, fuel system modifications, twin oil-coolers, etc. Powers Viscount 806 and early 810 Series.

Mk. 525 (RDa.7/1). Similar to 520 but with higher flame temperature. De-rated for take-off to 1,800 s.h.p. but with 2,100 s.h.p. available for climb and cruise. Powers later 810 Series Viscounts.

Mk. 526 (RDa.7/2). Rated at 1,910 s.h.p. (2,100 e.h.p.). For Armstrong Whitworth A.W.650 Argosy. 11 ft. 6 in. (3.50 m.) diameter airscrew.

Mk. 527 (RDa.7/2). Rated at 1,910 s.h.p. (2,100 e.h.p.). For Handley Page Herald.

Mk. 528 (RDa.7/1). Rated at 1,800 s.h.p. (1,960 e.h.p.). Alternative engine for Fokker F.27 Friendship.

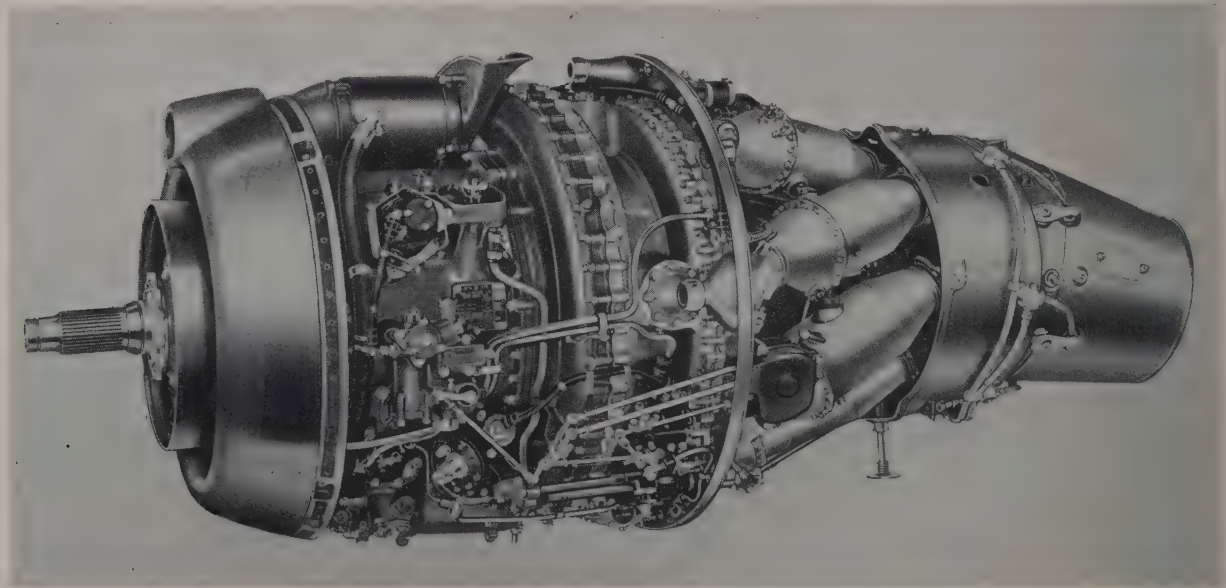
Mk. 529 (RDa.7/2). Rated at 1,910 s.h.p. (2,100 e.h.p.). For Grumman Gulfstream.

Mk. 540 (RDa.10). Increased mass air flow over that of 520, increased capacity compressor and higher compression ratio (6.35 : 1), higher flame temperature, air-cooled turbine blading in H.P. stage, strengthened reduction-gear, etc. 2,440 s.h.p. (2,660 e.h.p.). RDa.10 has completed a 25-hour flight approval test at a military rating of 3,200 s.h.p. using water-methanol to provide take-off boost.

Mk. 541 (RDa.11). De-rated version of RDa.10. For Viscount 840 Series.

Ratings, weights and dimensions of the above engines will be found in the Table overleaf.

The following details apply specifically



The 1,740 e.h.p. Rolls-Royce Dart RDa.6 (Mk. 510) turboprop engine.

to the Dart RDa.3, RDa.6 and RDa.7 engines :—

TYPE.—Turboprop with two-stage centrifugal compressor and two-stage (RDa.3 and 6) or three-stage (RDa.7) turbine.

REDUCTION GEAR.—Double reduction gearing with helical high-speed train and final spur (RDa.3) or helical (RDa.6 and 7) gear drive. The two gear trains connected by three layshafts. High-speed sun-wheel driven from forward end of impeller shaft with final drive through a large annulus splined to airscrew shaft. All gears and airscrew shaft carried in roller or ball bearings. Bevel gears from one of the layshafts provide drives to fuel and oil pumps and constant-speed unit. Bevel gear and engaging mechanism on sun-wheel shaft provide drive from starter motor. Reduction gear ratio 0.016 : 1 (RDa.3), 0.093 : 1 (RDa.6 and 7).

AIR INTAKE.—Circular intake with annular duct leading to impeller eye of first-stage compressor. Oil tank around intake is cast integral with casing. Secondary air intake supplies air to oil cooler mounted on top of casing.

COMPRESSOR.—Two-stage centrifugal-flow compressor. Each impeller has nineteen vanes and steel rotating guide vanes. Mass air flow at maximum r.p.m. 20 lb. (9.1 kg.) per sec. at 5.5 : 1 (RDa.3 and 6), 32 lb. (14.5 kg.) per sec. at 5.62 : 1 (RDa.7).

COMBUSTION CHAMBERS.—Seven straight-flow combustion chambers. Flame tubes in Nimonic 75 with fuel atomisers in front end of each tube for downstream injection. High-energy igniter plugs in Nos. 3 and 7 chambers.

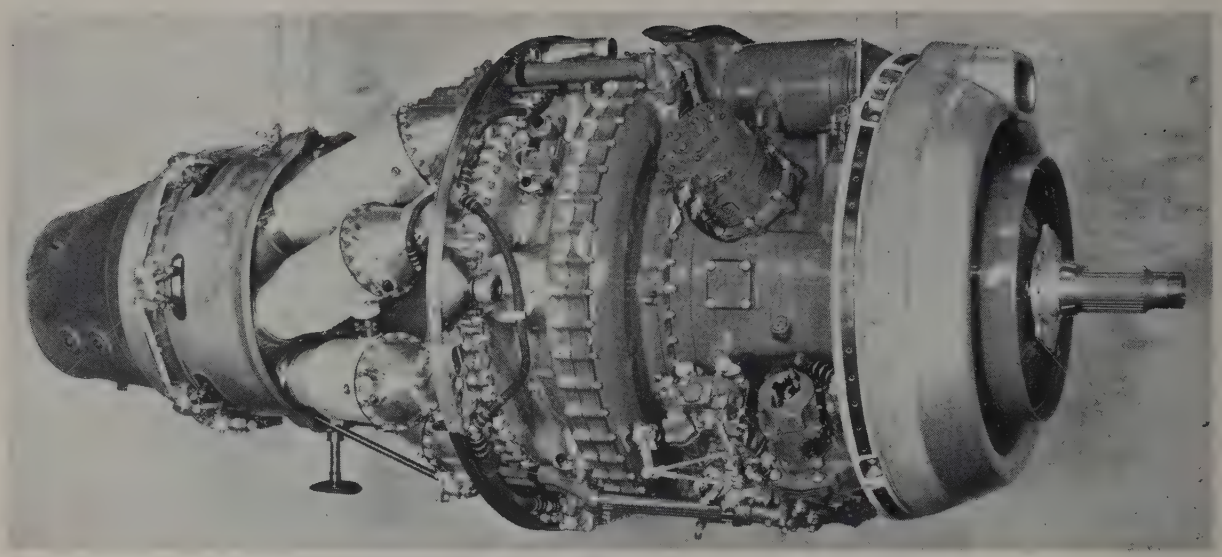
FUEL SYSTEM.—Single multi-plunger variable-stroke injection pump delivers fuel to burners and torch igniters (when fitted) through flow control unit, which incorporates a filter, throttle valve, shut-off cock and barometric pressure control solenoid. Operation of control unit is function of intake pressure and throttle valve pressure drop, thus determining fuel/air ratio for all engine operating conditions. Fuel pressure at burners varies from 40 lb./sq. in. (2.81 kg./cm.^{2}) at idling speed to 920 lb./sq. in. (64.6 kg./cm.^{2}) at maximum power. Automatically-progressive injection of water/methanol used to restore take-off power under high ambient temperature conditions. System inter-connected mechanically with throttle lever to ensure that it can only be used at take-off r.p.m. Fuel filter de-icing by hot air from compressor. Hot-air gate fitted to bottom engine mounting.

TURBINE.—Two-stage (RDa.3 and 6) or three-stage (RDa.7) axial-flow turbine. In RDa.3 and 6 the two discs coupled by single large annular unit and bolts co-axial with single shaft which forms direct drive to compressor. In RDa.7 first and second stage discs are bolted together by five bolts and all three by further five bolts, while drive shaft divided, with inner shaft connecting turbine with reduction gear and outer shaft with compressor. All blades of Nimonic alloy, and secured on discs by "fir-tree" type serrated roots.

EXHAUST UNIT.—Airscrew thrust line co-axial with engine main shaft but exhaust unit can be either straight or have a slight inclination to suit installation. Unit comprises an outer shell which supports an inner cone on three struts enclosed in aerofoil-section fairings to reduce turbulence and straighten gas flow at nozzle. Maximum jet pipe temperature 1,103°F. (595°C.).

ROLLS-ROYCE DART CENTRIFUGAL-FLOW TURBOPROP ENGINES.

Mark Number	Power (Basic S/L rating)	Specific Fuel Consumption (max. T.O. conditions)	Net Dry Weight (approx.)	Gear Ratio	Length (without jet pipe)	Diameter	Remarks
Mk. 505 (RDa.3)	1,540 e.h.p. (1,400 s.h.p. plus 365 lb. = 165 kg. jet thrust) at 14,500 r.p.m.	0.753 lb./e.h.p./hr. (0.341 kg./e.h.p./hr.)	1,030 lb. (468 kg.)	0.106 : 1	95 in. (2,413 mm.)	37.9 in. (963 mm.)	First production model. Powered early Vickers Viscount 700 Series.
Mk. 506 (RDa.3)	1,540 e.h.p. (1,400 s.h.p. plus 365 lb. = 165 kg. jet thrust) at 14,500 r.p.m.	0.727 lb./e.h.p./hr. (0.330 kg./e.h.p./hr.)	1,044 lb. (474 kg.)	0.106 : 1	95 in. (2,413 mm.)	37.9 in. (963 mm.)	Current standard engine in Viscount 700 Series. 10 ft. (3.05 m.) diameter airscrew.
Mk. 510 (RDa.6)	1,740 e.h.p. (1,600 s.h.p. plus 370 lb. = 168 kg. jet thrust) at 14,500 r.p.m.	0.690 lb./e.h.p./hr. (0.312 kg./e.h.p./hr.)	1,152 lb. (523 kg.)	0.093 : 1	97.6 in. (2,480 mm.)	37.9 in. (963 mm.)	Double helical reduction gear introduced. Powers Vickers Viscount 800 Series.
Mk. 511 (RDa.6)	1,720 e.h.p. (1,600 s.h.p. plus 310 lb. = 140 kg. jet thrust) at 14,500 r.p.m.	0.698 lb./e.h.p./hr. (0.316 kg./e.h.p./hr.)	1,182 lb. (536 kg.)	0.086 : 1	97.6 in. (2,480 mm.)	37.9 in. (963 mm.)	For Fokker F.27 Friendship. Same as Mk. 510 but 11 ft. 6 in. (3.50 m.) diameter airscrew.
Mk. 520 (RDa.7)	1,890 e.h.p. (1,700 s.h.p. plus 495 lb. = 225 kg. jet thrust) at 15,000 r.p.m.	0.700 lb./e.h.p./hr. (0.317 kg./e.h.p./hr.)	1,250 lb. (567 kg.)	0.093 : 1	97.6 in. (2,480 mm.)	37.9 in. (963 mm.)	Three-stage turbine, double shafting and new reduction gear. Powers Viscount 806.
Mk. 525 (RDa.7/1)	1,990 e.h.p. (1,800 s.h.p. plus 500 lb. = 227 kg. jet thrust) at 15,000 r.p.m.	0.680 lb./e.h.p./hr. (0.308 kg./e.h.p./hr.)	1,250 lb. (567 kg.)	0.093 : 1	97.6 in. (2,480 mm.)	37.9 in. (963 mm.)	De-rated RDa.7/2. Powers Viscount 810 Series.
Mk. 526 (RDa.7/2)	2,100 e.h.p. (1,910 s.h.p. plus 505 lb. = 229 kg. jet thrust) at 15,000 r.p.m.	0.660 lb./e.h.p./hr. (0.299 kg./e.h.p./hr.)	1,250 lb. (567 kg.)	0.093 : 1	97.6 in. (2,480 mm.)	37.9 in. (963 mm.)	Standard and fully-rated RDa.7. Powers Armstrong Whitworth A.W.650 Argosy. 11 ft. 6 in. (3.50 m.) airscrew.
Mk. 527 (RDa.7/2)	2,100 e.h.p. (1,910 s.h.p. plus 505 lb. = 229 kg. jet thrust) at 15,000 r.p.m.	0.660 lb./e.h.p./hr. (0.299 kg./e.h.p./hr.)	1,250 lb. (567 kg.)	0.093 : 1	97.6 in. (2,480 mm.)	37.9 in. (963 mm.)	Powers Handley Page Herald. 12 ft. 6 in. (3.81 m.) airscrew.
Mk. 528 (RDa.7/1)	1,960 e.h.p. (1,800 s.h.p. plus 500 lb. = 227 kg. jet thrust) at 1,500 r.p.m.	0.690 lb./e.h.p./hr. (0.312 kg./e.h.p./hr.)	1,250 lb. (567 kg.)	0.093 : 1	97.6 in. (2,480 mm.)	37.9 in. (963 mm.)	Alternative engine for Fokker F.27 Friendship. 11 ft. 6 in. (3.50 m.) airscrew.
Mk. 529 (RDa.7/2)	2,100 e.h.p. (1,910 s.h.p. plus 505 lb. = 229 kg. jet thrust) at 15,000 r.p.m.	0.660 lb./e.h.p./hr. (0.299 kg./e.h.p./hr.)	1,250 lb. (567 kg.)	0.093 : 1	97.6 in. (2,480 mm.)	37.9 in. (963 mm.)	Powers Grumman Gulfstream. 11 ft. 6 in. (3.50 m.) airscrew.
Mk. 540 (RDa.10)	2,660 e.h.p. (2,440 s.h.p. plus 670 lb. = 304 kg. jet thrust) at 15,000 r.p.m.	0.640 lb./e.h.p./hr. (0.290 kg./e.h.p./hr.)	1,323 lb. (600 kg.)	0.093 : 1	89.5 in. (2,502 mm.)	37.9 in. (963 mm.)	Increased mass flow (16%), compressor first stage enlarged and compression ratio increased (6.35 : 1), air-cooled turbine blading in H.P. stage, etc. Currently, most powerful Dart.
Mk. 541 (RDa.11)	2,350 e.h.p. (2,100 s.h.p. plus 655 lb. = 297 kg. jet thrust) at 15,000 r.p.m.	0.675 lb./e.h.p./hr. (0.306 kg./e.h.p./hr.)	1,323 lb. (600 kg.)	0.093 : 1	89.5 in. (2,502 mm.)	37.9 in. (963 mm.)	De-rated RDa.10. Powers Viscount 840 Series.



The 2,105 e.h.p. Rolls-Royce Dart RDa.7/2 (Mk. 529) turboprop engine.

ACCESSORY DRIVES.—An accessory gear-box drive is taken from the main-shaft centre-coupling immediately behind compressor through a train of gears, to a housing on top of intermediate casing; a universal coupling provides final drive to gear-box.

LUBRICATION.—Entirely self-contained. Integral oil tank (total capacity 25 pints= 14 litres) has two compartments, one for engine requirements and other for airscrew feathering. Gear pump supplies oil to all bearings and reduction-gear jets at nominal pressure of 30 lb./sq. in. (2.10 kg./cm.²) and at nominal flow of 460 Imp. gallons (2,091 litres) per hour. Combined delivery from four scavenge pumps returned to tank *via* oil-cooler on top of intake casing. Pressure and scavenge pumps in single housing and driven by common shaft.

CONTROLS.—Only two cockpit controls, a throttle lever for varying power and a high-pressure cock for stopping engine. Throttle valve is interconnected with the airscrew controller and high-pressure cock is linked with airscrew feathering controls. Blades may be feathered by moving shut-off cock lever past the closed position; depression of an unfeathering button returns blades to fine pitch. To avoid undue load when starting, a cut-out connected with the airscrew prevents engine starting system from operating unless blades are in zero pitch. Safety device prevents airscrew from going into zero pitch unless aircraft weight is on landing-gear.

MOUNTING.—Four feet are provided at 90° on the horizontal and vertical centre-lines of compressor casing, although only three need be used. Bottom foot for hot-air gate valve. No rear mounting is required, but jet pipe if used requires separate mounting in airframe.

DIMENSIONS, WEIGHTS AND PERFORMANCE.—See Table.

CANADA

BRISTOL

BRISTOL AERO ENGINES, LTD.

HEAD OFFICE AND WORKS: 10210 PIE IX BOULEVARD, MONTREAL NORTH, 12, QUEBEC.

Directors: R. J. Reynolds (Chairman); Air Vice-Marshal A. L. James (President); B. A. Chalmers (Vice-President); Sir Reginald Verdon Smith; J. H. Holt; J. A. Limoges; D. Ross McMaster, Q.C.

General Manager: L. W. Smith.

Secretary: A. F. B. Milligan.

Treasurer: J. R. Alarie.

This company was formed in 1951 through the acquisition of Canadian Wright Ltd., an old-established member of the Canadian aircraft industry. It operates from a modern plant, completed in 1953, which is equipped with the most up-to-date facilities for aero-engine overhaul.

Major current activity is the overhaul and reconditioning of the Wright Turbo Compound engines of Fairchild C-119 and Lockheed Neptune aircraft of the R.C.A.F. and Lockheed Super Constellations of T.C.A. The company also overhauls the Rolls-Royce Merlin engines of R.C.A.F. Avro Lancaster and Canadair North Star aircraft. Non-aviation work includes the overhaul of Meteor tank engines for the Canadian army. Employment totalled 520 persons at the beginning of 1958.

BRISTOL AERO ENGINES (WESTERN) LTD.

HEAD OFFICE AND WORKS: VANCOUVER AIRPORT, B.C.

Directors: R. J. Reynolds (Chairman); Air Vice-Marshal A. L. James (President); J. H. Holt (Vice-President and General Manager); B. A. Chalmers (Vice-President); Sir Reginald Verdon Smith; W. H. K. Edmonds; W. R. C. Patrick.

Secretary-Treasurer: D. M. Grant.

This is the western counterpart of Bristol's Montreal plant. At its modernized fully-equipped works the Company carries out the overhaul of Pratt & Whitney and Wright engines for the R.C.A.F., and for several commercial airlines operating throughout Western Canada. In addition, the repair of airscrews, carburettors and fuel injection systems is an important function.

The Vancouver Company plays a major part in the repair and overhaul of the Proteus engines of Canadian Pacific Air Lines' Britannia fleet. It employed 125 persons at the beginning of 1958.

ORENDA

ORENDA ENGINES, LIMITED.

HEAD OFFICE AND WORKS: MALTON, ONTARIO.

POSTAL ADDRESS: BOX 4015, TERMINAL "A", TORONTO.

Chairman: F. T. Smye.

President: W. R. McLachlan.

Executive Vice-President and General Manager: E. K. Brownridge.

Vice-President—Engineering: C. A. Grinyer.

Vice-President—Sales and Service: Paul Y. Davoud.

Chief Engineer: F. H. Keast.

Orenda Engines, Ltd., a member of A. V. Roe Canada, Ltd., and the Hawker Siddeley Group, was originally the Gas Turbine Division of the former, but was constituted as a separate company under its present name on January 1, 1955. It is the only company in Canada engaged in the full cycle of design, development and production of aero-engines.

The 3,794th, and last, Orenda turbojet was delivered on June 18, 1958. This type of engine continues in service in Avro CF-100 and Canadair Sabre fighters.

The latest Orenda product is the Iroquois turbojet, which is still under development. All available details of this engine appear hereafter.

New high altitude, combustion, aerodynamic, afterburner and blade-cooling facilities and new development test cells are among the latest additions to Orenda's total facilities, which comprise over one million square feet. These are located mainly at Malton, but the company also maintains a full-scale test establishment at Nobel, Ontario, 170 miles to the north.

A subsidiary company named Orenda Industrial Ltd. was formed in the Spring of 1958 to supply diesel power units to Canadian industry.

THE IROQUOIS.

Design of the Iroquois, then known as the PS-13, was started in September, 1953, with the object of producing an engine capable of high performance at supersonic speeds. An official Instruction to Proceed with its development was received from the Canadian Department of Defence Production on January 13, 1954 and the first prototype engine ran for the first time on December 17 that year. Since then various special-category tests have been completed with numerous prototypes.

The Iroquois is a two-spool axial-flow turbojet, having an integral close-coupled afterburner and a fully-variable exhaust nozzle. It has multi-stage low-pressure and high-pressure compressors, an annular combustion chamber and independent high-pressure and low-pressure turbines. Its air mass flow has been reported as about 335 lb./sec. (152 kg./sec.), with a pressure ratio of about 8 : 1.

Great emphasis has been placed on simplicity and low weight. The Iroquois with reheat contains fewer parts than the much lower-powered Orenda turbojet without reheat, and 20% of the finished weight of the engine is composed of titanium alloys. In particular, the discs, spacers and blades of the compressors are made of titanium, except for the final stages of the high-pressure spool, which are of steel. Turbine blades are cast from Inconel 700 and 713.

A two-piece casing, in upper and lower halves, is used over the low-pressure compressor; but the casing over the high-pressure compressor is made as a single piece. Air is tapped from the compressor to cool the turbine discs, seal the oil sumps and de-ice the four streamlined struts inside the intake, which bear the loads of the front bearing and carry the large electric alternator. The fuel system and other accessories are housed in a fireproof ventilated shroud under the compressors. The fuel system and nozzle control have been designed and manufactured by Lucas-Rotax.

Initial flight testing of the Iroquois is being done inside a large nacelle built on to the side of the rear fuselage of a Boeing B-47 bomber.

The Iroquois has been chosen to power the Avro Arrow Mk. 2 twin-engined supersonic interceptor.

DIMENSIONS (all approx.).—
Overall length with afterburner 228 in. (5,790 mm.).
Overall length without alternator frame 204 in. (5,180 mm.).
Intake diameter 42 in. (1,070 mm.).
Afterburner diameter 47 in. (1,194 mm.).

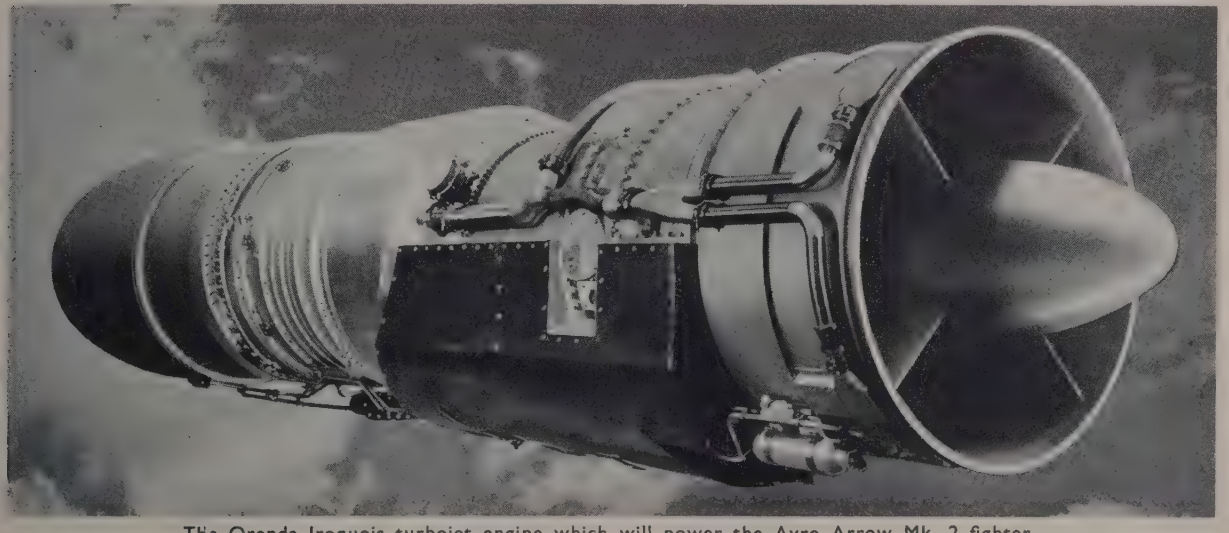
WEIGHT.—
Thrust/weight ratio over 5 : 1.

PERFORMANCE.—
In 20,000 lb. (9,080 kg.) s.t. class (dry).

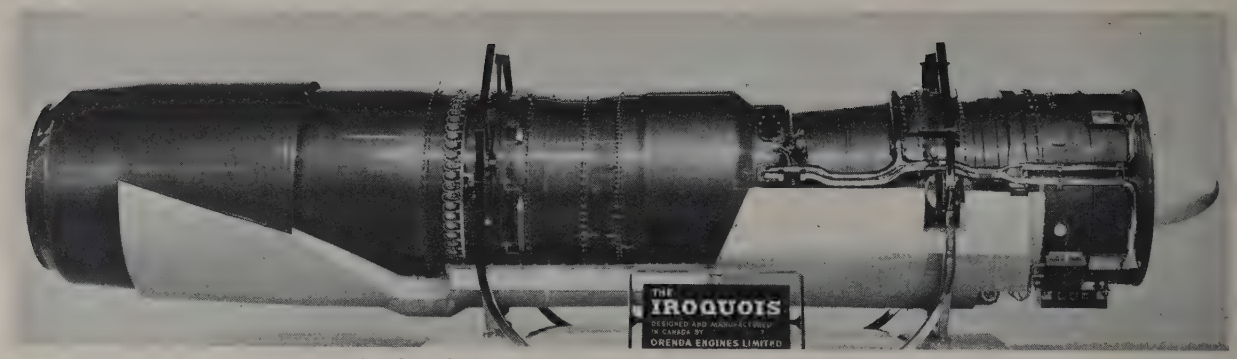
CONSUMPTIONS.—
Fuel under 1.0 lb./lb. s.t./hr. (1.0 kg./kg. s.t./hr.) dry, and under 2.0 lb./lb. s.t./hr. (2.0 kg./kg. s.t./hr.) with afterburner.

THE ORENDA.

The Orenda ran for the first time in February, 1949, and first flew as prime mover in a North American F-86A at the



The Orenda Iroquois turbojet engine which will power the Avro Arrow Mk. 2 fighter.



An Orenda Iroquois turbojet engine with afterburner.

Edwards A.F.B., Muroc, California, in October, 1950. On June 20, 1951, the Avro Canada CF.100 two-seat long-range all-weather interceptor fighter, for which the Orenda engine was specifically designed, made its first flight powered by two Orenda engines.

The following versions have been announced :—

Orenda 1. Original design. First ran in February, 1949, thirty months after the design was initiated.

Orenda 2. First production version. Passed its type test in February, 1952. Essentially the Orenda 1 with modified suspension and reduced weight.

Orenda 3. An Orenda 1 modified for installation in a special F-86A. This was the first model to fly under its own power.

Orenda 8. Modified compressor to improve acceleration characteristics. Incorporates Bendix flow-control unit containing acceleration controller. Arrangement of accessories such that right and left-hand engines are required for the CF-100 installation. Passed type test in January, 1953.

Orenda 9. Basically a left-hand Series 8 engine with minor external modifications so that the engine is suitable for installation in either right or left-hand nacelle of CF.100 Mk. 4. Incorporates alcohol anti-icing of engine intake.

Orenda 10. Basically an Orenda 8 engine with minor external modifications for installing in Canadair Sabre Mk. 5. Incorporates Delco starter-generator in nose bullet instead of Jack & Heintz electric starter in other models. Uses aircraft oil tank instead of integral engine oil supply as on all other models. As with all the above engines the Orenda 10 is in the 6,355 lb. (2,885 kg.) static thrust category.

Orenda 11. Development of Orenda 9 with two-stage turbine. Pressure ratio 6.1 : 1. Has Bendix-Scintilla high-energy ignition. Develops 7,500 lb. (3,400 kg.) s.t., with specific fuel consumption at maximum r.p.m. of 0.997 lb./lb. s.t./hr. (0.997 kg./kg. s.t./hr.). Type-tested in January, 1954.

Orenda 14. Similar to Orenda 11 but adapted for installation in Canadair Sabre Mk. 6. Same rating as Orenda 11. Type-tested in September, 1954.

The description which follows applies specifically to the Orenda Series 9 although the general structural description may be taken to cover all versions.

TYPE.—Axial-flow turbojet.

AIR INTAKE.—Annular intake surrounding nose bullet. Intake frame houses power take-off, supports electric starter and provides for attachment of debris guard and intake fairing. Radial struts of frame carry starter leads and various other engine services. De-icing by alcohol-distributing fairing spinner. Inlet air flow 106 lb./sec. (48 kg./sec.).

COMPRESSOR.—Ten-stage axial-flow compressor made up of nine aluminium-alloy discs and one steel disc mounted on three aluminium-alloy drums bolted together. Stages 1-9 shrunk on ; 10th stage bolted. Pads on an annular duct at 8th stage are available for air bleed for aircraft services. Split magnesium-alloy casing with nine rows of aluminium-alloy stator blades and one row of steel stator blades. Pressure ratio 5.5 : 1. Air mass flow 106 lb. (48 kg.) sec.

COMBUSTION CHAMBERS. — Six interconnected straight-through chambers each with a concentrically-mounted flame tube having a burner in the front end and discharging down-stream. Lucas-Duplex III burners, one in each chamber mounted on centre casing. Interconnectors between Nos. 1 and 2 and Nos. 5 and 6 chambers each carry torch igniter atomiser and igniter plug.

FUEL SYSTEM.—Fuel delivered by two Lucas Type GC200 high-pressure variable-stroke pumps through Bendix TJ-52 flow control unit, which embodies the air/fuel ratio controller, and a Lucas flow distributor valve. Maximum fuel pressure 2,000 lb./sq. in. (140 kg./cm.^{2}).

FUEL.—3-GP-22A (MIL-F-5624A Grade JP-4)

TURBINE.—Single-stage turbine consisting of an austenitic steel disc with nickel-chromium blades inserted in its periphery by "fir" tree fixings. Centre and rear bearings and both faces of turbine disc cooled by compressor air bled from second and fifth stages and by leakage air from tenth stage peripheral seal. Gas temperatures 300°C. before and 75°C. after turbine,

JET PIPE.—Fabricated from 321 stainless steel sheet with cast steel flanges at front and rear. Bullet support by four tabular struts which pass through four large straightener vanes. Front face of bullet double-walled with fiberglas insulation between. Outer jet-pipe casing lagged with insulation blanket.

ACCESSORY DRIVES.—From front end of compressor shaft through vertical shafts to bevel-drive gearbox above and oil pump gearbox below. Shaft from upper bevel drive operates auxiliary gear box which carries two fuel pumps and a tachometer generator. Connection provided on oil pump gearbox to drive shaft to a separate accessories gearbox mounted in the airframe.

LUBRICATION.—Dry sump type. Nichols main and auxiliary scavenge pump. Pressure oil supplied to rotor bearings, gear boxes, front bearing seal and drive-shaft flexible coupling through ring main. Used oil collects in three separate sumps. Relatively cool oil from front sump is returned directly to tank while hot oil from two rear sumps returns to tank through cooler which uses engine fuel as coolant. Capacity of integral oil tank 17.3 Imp. pints. Maximum oil temperatures 70°C. (158°F.) at ring main, 140°C. (284°F.) at central bearing scavenge. Oil specification MIL-0-6018B.

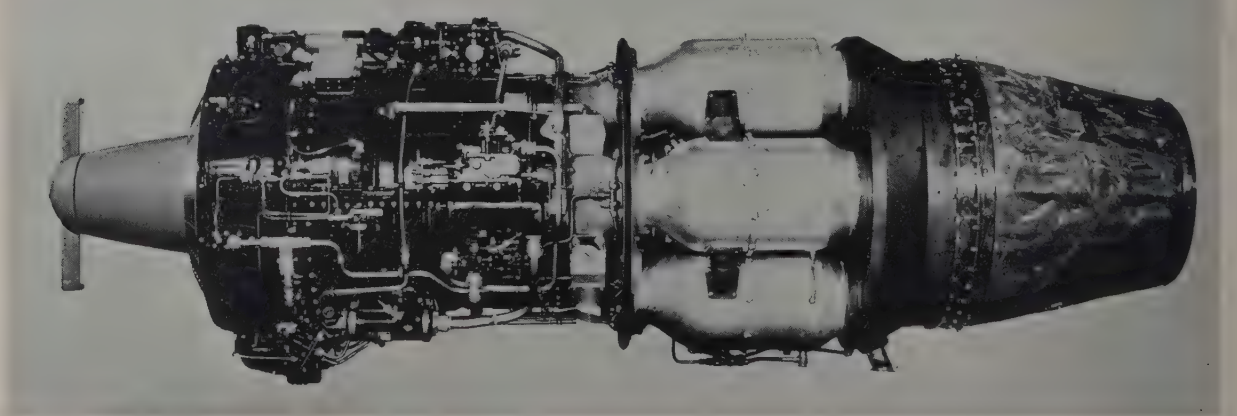
MOUNTING.—Three-point suspension with two trunnions on centre casing and an adjustable strut on backbone ahead of turbine nozzle box.

IGNITION.—Two GLA high-intensity igniter plugs and two Orenda torch igniters fed through solenoid-operated reducing valve from high-pressure fuel line.

STARTING.—Jack and Heintz D.26 28.5 volt electric starter with outside power source.

DIMENSIONS.—

Nominal diameter 42 in. (1,070 mm.).
Length of engine (from front face of intake screen to rear of exhaust cone) 121.5 in. (3,090 mm.).
Length overall 143.6 in. (3,647 mm.).



The Orenda Series II engine (7,500 lb.=3,400 kg. s.t.), a development of the Series 9 with a two-stage turbine.

WEIGHTS.—
Dry 2,560 lb. (1,160 kg.).
PERFORMANCE RATINGS.—
Max. rating 6,355 lb. (2,885 kg.) at 7,800 r.p.m.
Military rating 5,870 lb. (2,547 kg.) at 7,600 r.p.m.
Normal rating 5,020 lb. (2,280 kg.) at 7,250 r.p.m.
FUEL CONSUMPTIONS.—
Max. 1.119 lb./lb. s.t./hr. (1.119 kg./kg. s.t./hr.).
Military 1.100 lb./lb. s.t./hr. (1.100 kg./kg. s.t./hr.).
Normal 1.05 lb./lb. s.t./hr. (1.05 kg./kg. s.t./hr.).
OIL CONSUMPTIONS.—
Max. 2 pints/hr. (1.135 litres/hr.).
Normal 1 pint/hr. (0.5675 litres/hr.).

ROLLS-ROYCE

ROLLS-ROYCE OF CANADA, LTD.

HEAD OFFICE AND WORKS: CÔTE DE LIESSE ROAD, NEAR MONTREAL, P.Q.

General Manager: R. M. Kendall.

Works Manager: David Boyd, O.B.E.

Rolls-Royce of Canada, Ltd. was formed in 1952 to undertake the assembly and manufacture of Rolls-Royce gas-turbine engines and to supply the necessary overhaul, technical service and spare parts for Rolls-Royce products in North America.

The completion early in 1958 of a $1 million extension, including an additional test-bed, has enabled Dart engine facilities to be provided.

Manufacture of the Nene 10 turbojet engine for installation in the Silver Star (T-33A) two-seater jet trainer in production for the R.C.A.F. by Canadair, Ltd. has been completed, but the manufacture of spare parts and overhaul work are continuing in the factory.

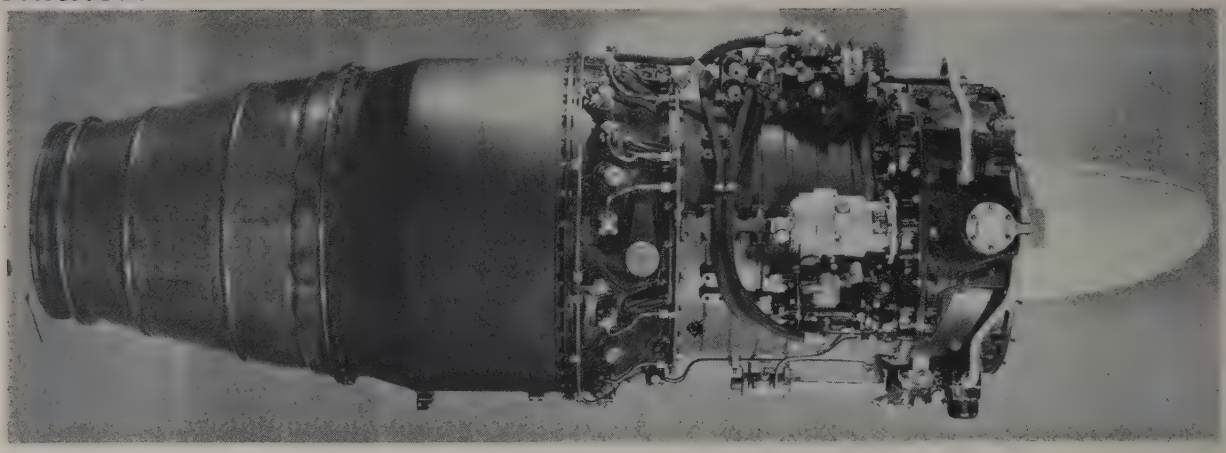
The company is also overhauling Westinghouse J34 turbojets for the Royal Canadian Navy.

Technical service and spare parts for the Merlin and Dart engines of Trans-Canada Air Lines are being provided from Montreal, and similar service is being provided for the Merlin and Nene engines in the Royal Canadian Air Force and the Dart engines which power the Viscounts in service with operators in the United States. This service will be extended eventually to cover the Dart engines of the Fairchild F-27 and Grumman Gulfstream. It will also apply to the Conway and Tyne when these engines come into operation in North America in 1959-60.

Dart engine overhaul facilities will be provided at Montreal from the beginning of 1958.

FRANCE

DASSAULT



The Dassault M.D. 30 Viper turbojet engine (740 kg.=1,630 lb. s.t. at sea level).

GÉNÉRALE AÉRONAUTIQUE MARCEL DASSAULT.

HEAD OFFICE: 78, QUAI CARNOT, SAINT-CLOUD (SEINE-ET-OISE).

WORKS: SAINT CLOUD (SEINE).

Director-General: M. B. C. Vallières.

In 1953 Dassault acquired the licence to build the Armstrong Siddeley "long-life" Viper turbojet engine in France. The licence-built engine carries the designation M.D. 30 Viper.

Dassault has undertaken considerable engineering work in adapting the Viper to certain specific requirements, including the development of an afterburner.

The first application of M.D. 30 to a French airframe was in the S.O. 9000 Trident turbojet/rocket powered research monoplane in which two Vipers were installed at the wing tips. In this installation the two engines were "handed" with the accessories mounted on the inboard sides.

Dassault-built Vipers have subsequently powered the developed S.O.9050 Trident II and the Dassault M.D. 550 Mirage I research interceptor, the latter being fitted with two M.D. 30 Vipers with afterburners.

The company has developed from the Viper a new and more powerful turbojet known as the Farandole, of which two will power the Dassault Méditerranée light jet transport aircraft.

THE DASSAULT M.D. 30 VIPER.

The M.D. 30 turbojet has a seven-stage axial-flow compressor, an annular combustion chamber and a single-stage turbine. The compression ratio is 3.8 : 1 and the mass air-flow at 13,400 r.p.m. at sea level is 14 kg. (30.8 lb.) per second. A general description of the Viper will be found under "Armstrong Siddeley" (Great Britain).

DIMENSIONS.—
Diameter 680 mm. (26.77 in.).
Length (without afterburner) 1,672 mm. (66 in.).
Length (with afterburner) 3,350 mm. (131.9 in.).

WEIGHT DRY.—
Without afterburner 225 kg. (496 lb.).
With afterburner 345 kg. (761 lb.).

RATINGS.—
Take-off, without afterburner 740 kg. (1,630 lb.) s.t. at 13,400 r.p.m.
Take-off, with afterburner 1,000 kg. (2,200 lb.) s.t. at 13,400 r.p.m.

CONSUMPTIONS.—
Fuel (without afterburner) 1.10 kg./kg. s.t./hr. (1.10 lb./lb. s.t./hr.).
Fuel (with afterburner) 2.30 kg./kg. s.t./hr. (2.30 lb./lb. s.t./hr.).

THE DASSAULT R.7 FARANDOLE.

The Dassault Farandole is virtually a 1.3 : 1 scaled-up version of the Armstrong Siddeley Viper ASV.10 turbojet. It first ran in December 1956, and an afterburning version with an output of 1,850 kg. (4,080 lb.) s.t. is also under development.

TYPE.—Axial-flow turbojet.

AIR INTAKE.—Annular surrounding nose bullet. Inlet air flow 25.4 kg./sec. (55 lb./sec.).

COMPRESSOR.—Seven-stage axial flow. Steel stator blades are dove-tailed in grooves in outer casing. Rotor blades, of which first row are steel and remainder aluminium, secured in peripheries of discs, first row by fir-tree serrations, remainder by riveting. Discs splined to steel shaft, which is carried on front twin ball-bearing and rear roller bearing. Compression ratio 3.8 : 1. Mass air flow 25.4 kg./sec. (55 lb./sec.).

COMBUSTION CHAMBER.—Single annular type, mainly of Nimonic 75. Vaporiser type burners. Two high-energy igniters.

FUEL SYSTEM.—Armstrong Siddeley type. Maximum fuel pressure 25.3 kg./cm.^{2} (360 lb./sq. in.).

FUEL GRADE.—Kerosene AIR 3405 or JP4.

NOZZLE GUIDE VANES.—Single row of aerofoil type blades of Jessop G.39 steel.

TURBINE.—Single-stage axial flow. Disc of Rex 448 austenitic steel with blades of Nimonic 90 secured in periphery by fir-tree serrations. Turbine disc secured to shaft by Hirth coupling.

JET PIPE.—Fixed type. Cone and pipe of stainless steel sheet.

ACCESSORY DRIVES.—On side and front intake.

AFTERBURNER.—Details not available. Provides 32 per cent. increase in thrust.

LUBRICATION.—Circulation on front bearing, "total loss" on centre and rear bearing. Normal supply pressure 2.60 kg./cm.^{2} (37 lb./sq. in.).

OIL SPECIFICATION.—DERD.2487.

MOUNTING.—Two trunnions at mid-length of engine and steady point on turbine flange.

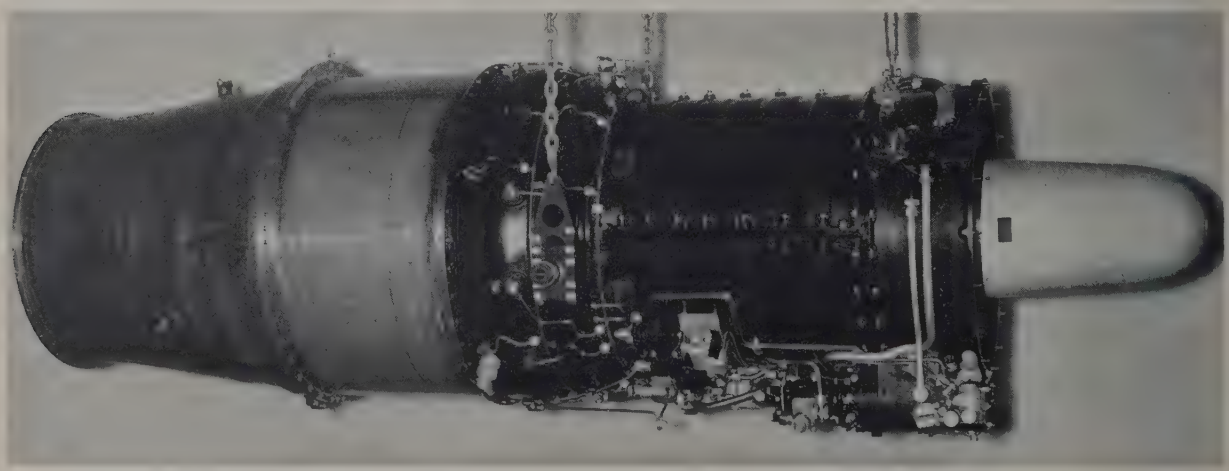
STARTING.—Electric, or by supply of compressed air on turbine blades.

DIMENSIONS.—
Diameter 730 mm. (28.75 in.).
Length from front face of intake to rear face of exhaust cone 2,000 mm. (78.8 in.).

WEIGHT.
Equipped 340 kg. (750 lb.).

PERFORMANCE RATINGS.—
Max. take-off without afterburner 1,400 kg. (3,100 lb.) at 11,800 r.p.m.
Max. take-off with afterburner 1,850 kg. (4,080 lb.) s.t.

FUEL CONSUMPTION.—
At max. static 1.07 kg./kg. s.t./hr. (1.07 lb./lb. s.t./hr.).



The Dassault R.7 Farandole turbojet engine (1,400 kg.=3,100 lb. s.t.).

HISPANO-SUIZA

SOCIÉTÉ D'EXPLOITATION DES MATÉRIELS HISPANO-SUIZA.

HEAD OFFICE AND WORKS: RUE DU CAPITAINE GUYNEMER, BOIS-COLOMBES (SEINE).

The Hispano-Suiza company entered the turbojet field by acquiring the licence to build the Rolls-Royce Nene and Tay engines.

The first production engine was the Nene for installation in the Sud-Est Mistral and the Dassault Ouragan. It was followed by the Tay, which powers the Dassault Mystère II and Mystère IV. A Tay-engined Mystère II was the first French aircraft to exceed the speed of sound.

The Verdon, developed from the Tay in the same way that the Tay was evolved from the Nene, powers the Mystère IVA.

Hispano-Suiza has also undertaken considerable development work in both engines and afterburners. To further this work, Hispano have signed an agreement with Turbomeca under which the two companies established on April 23, 1956, a joint organisation named Compagnie Générale des Turbo-machines (C.G.T.M.) for technical co-operation in all fields of gas-turbine research and development.

THE HISPANO-SUIZA R.804.

The R.804 is a small axial-flow turbojet engine which has been developed from the earlier R.800 turbojet, described in previous editions of this work. It was intended to meet an official requirement for a power-plant suitable for lightweight fighter aircraft and is suitable for speeds up to Mach 1.8.

On March 23, 1957, the R.804 completed successfully a 150-hour endurance test at its design rating of 1,500 kg. (3,306 lb.) s.t.

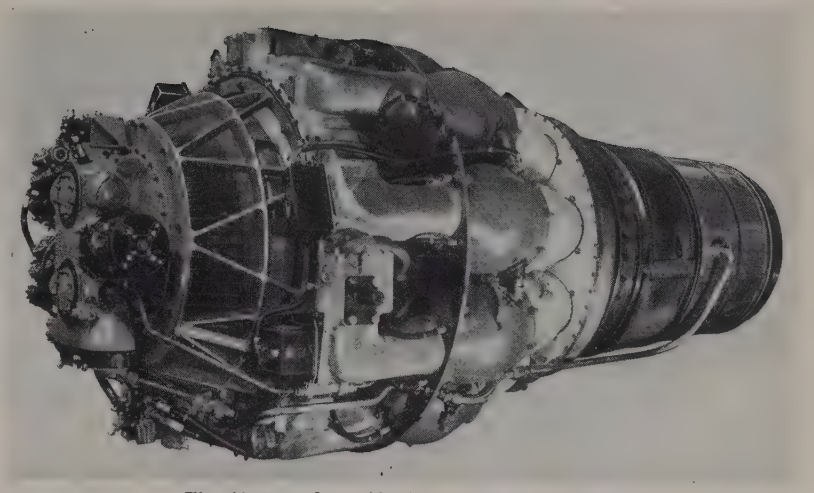
TYPE.—Axial-flow turbojet.

COMPRESSOR.—Seven-stage axial type. Compression ratio 4.8 : 1. Air mass flow 26 kg./sec. (57.3 lb./sec.).

COMBUSTION CHAMBER.—Annular type with ten Duplex fuel burners.

NOZZLE GUIDE VANES.—Hollow steel guide vanes with air-cooling.

TURBINE.—Single-stage turbine with blades machined from Nimonic 80A alloy. Blade roots and both sides of turbine disc cooled by air bled from compressor.



The Hispano-Suiza Verdon 350 turbojet engine.

ACCESSORY DRIVES.—Gearbox integrated in engine operates accessories of the high-pressure fuel system and lubrication system, and two upper and one lateral power take-off for accessory drives.

STARTING.—Electric starter.

DIMENSIONS.—
Length without jet-pipe and propelling nozzle 2,154 mm. (84.8 in.).
Diameter 690 mm. (27.2 in.).

WEIGHT.—
Weight without starter and jet-pipe 308 kg. (679 lb.).

PERFORMANCE.—
Max. rating without afterburner 1,500 kg. (3,306 lb.) s.t. at 12,000 r.p.m.

CONSUMPTION.—
Fuel at 1,500 kg. (3,306 lb.) s.t. 1.068 kg./kg. s.t./hr. (1.068 lb./lb. s.t./hr.).

THE HISPANO-SUIZA R.854.

The R.854 is the R.804 fitted with an afterburner. It develops 2,020 kg. (4,450 lb.) s.t., with a specific fuel consumption of 2.0 kg./kg. s.t./hr. (2.0 lb./lb. s.t./hr.) at maximum power.

DIMENSIONS.—
Length overall 3,700 mm. (146 in.).
Diameter 660 mm. (26 in.).

WEIGHT.—
Dry, less tailpipe 385 kg. (850 lb.).

THE HISPANO-SUIZA VERDON 350

The Verdon 350 is a development of the Tay 250, the principal modifications being generally similar to those employed to evolve the Tay from the Nene. These include internal changes to permit a greater flow of air through the engine; an increase in turbine speed; and a slight increase in the permissible gas temperature after the turbine. In other respects, the Verdon uses the greatest possible number of Tay components and is installationally interchangeable with the Tay.

The Verdon was first flown in a Dassault Mystère on August 3, 1953 and over 550 had been delivered by July, 1957.

DIMENSIONS.—
Max. diameter 1.27 m. (50 in.).
Length 2.62 m. (103.2 in.).
Frontal area 1.26 m.² (13.6 sq. ft.).

WEIGHT.—
Dry 935 kg. (2,057 lb.).

PERFORMANCE RATINGS.—
Take-off 3,500 kg. (7,700 lb.) s.t. at 11,100 r.p.m. at sea level.
Max. continuous 3,150 kg. (6,945 lb.) s.t. at 10,800 r.p.m. at sea level.
Cruising 2,800 kg. (6,160 lb.) s.t. at 10,500 r.p.m. at sea level.

CONSUMPTIONS.—
Fuel (max.) 1.1 kg./kg. s.t./hr. (1.1 lb./lb s.t./hr.).
Oil 0.25 kg./hr. (0.55 lb./hr.).

SEPR

SOCIÉTÉ D'ÉTUDE DE LA PROPULSION PAR RÉACTION.

HEAD OFFICE: 37, RUE DES ACACIAS, PARIS (17E).

WORKS: ARGENTEUIL, ISTRES, VILLAROCHE AND VILLEJUIF.

President: Georges Glasser.

Director General: Jean Volpert.

Assistant Director General and Technical Director: Fernand Florio.

The Société d'Etude de la Propulsion par Réaction was formed in 1944 to design and develop rocket motors for piloted aircraft and guided weapons. Initially, it based its work on German wartime research; but has since made great advances in original design and construction and is now the largest manufacturer of rocket-engines on the Continent of Europe. It employs some 950 persons.

S.E.P.R. liquid-propellent rocket-engines all use nitric acid as oxidant. The first was the S.E.P.R. 25 and one of these engines equipped the S.O. 6025 Espadon which made the first flight by a French rocket-powered aircraft on June 10, 1952. Since then, S.E.P.R. engines have been fitted in the S.O. 9000 Trident I, S.O. 9050 Trident II, S.E. 212 Durandal, Dassault Mirage I, II and III, experimental versions of the Dassault Mystère IV and other types. The company also produces a wide range of solid-propellent and liquid-propellent rockets as primary power plants and boosters for guided missiles.

THE S.E.P.R. 481.

First self-contained S.E.P.R. rocket-engine, this unit was developed for the S.O. 9000 Trident I aircraft and consisted of a turbopump supplying three chambers of the type fitted to the earlier S.E.P.R. 25 engine, together with a complete control system. Its great length results from the fact that the airframe designers asked that the turbopump should be located near the wing trailing edge and the combustion chambers at the tail.

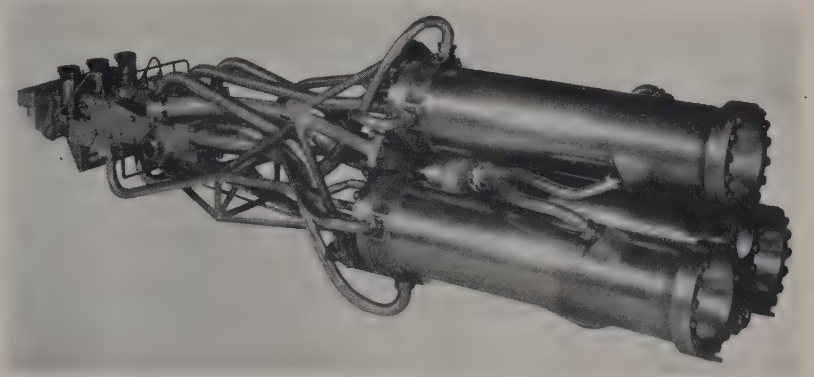
Engines of this type made 1,100 ground runs and 120 flights in the Trident in 2½ years without any serious failure, enabling the aircraft to exceed its design speed of Mach 1.6.

TYPE.—Liquid bi-propellent Rocket.

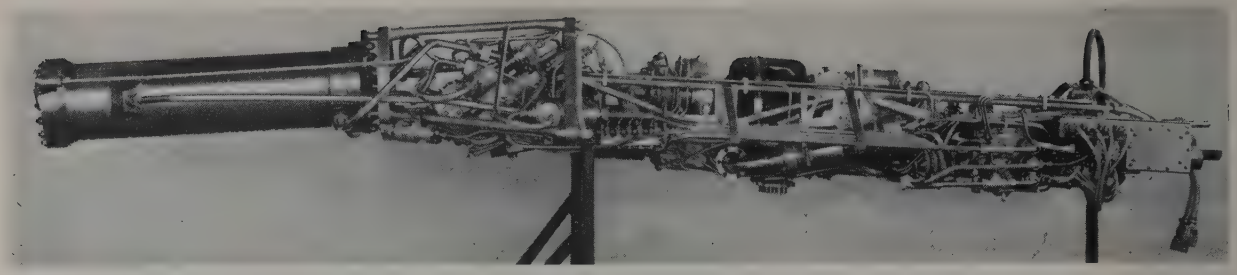
PUMPS.—Two main pumps and three auxiliary pumps, all of the centrifugal type.

TURBINE.—Single-stage impulse turbine fed by six injector nozzles located around inlet housing.

GAS GENERATOR.—Similar to combustion chambers, but cooled externally by water



The combustion chambers of the S.E.P.R. 481 (4,800 kg. = 10,600 lb. s.t.).



The S.E.P.R. 660 rocket motor (1,500 kg.=3,300 lb. s.t.).

circulation and internally by water injection.

COMBUSTION CHAMBERS.—Three similar chambers of light alloy, each consisting of two concentric shells between which the nitric acid regenerative coolant is circulated. One propellent distributor feeds the three chambers independently.

PROPELLENTS.—Nitric acid and furaline or Tx., with methanol alcohol-water mixture for gas generator.

CYCLE OF OPERATION.—The starting switch opens the water tank valve by means of an actuator and energises an electric starter which begins to drive the three auxiliary pumps. Pressure delivered by the auxiliary water pump, when it reaches its rated value, opens the oxidant and fuel tank valves, and the propellents are fed to the gas generator by the auxiliary pumps. The generator feeds the turbine which, in turn, drives the main propellent pumps. As soon as the turbine reaches half its rated speed, it begins to drive the auxiliary pumps also and power supply to the electric starter is cut off. The propellents flow in a closed circuit until the discharge pressure of the pumps reaches its minimum rated value. Then the distributor valves of the combustion chambers open, admitting the propellents, and the chambers fire. Either one, two or all three chambers can be selected to fire by the pilot, as desired.

DIMENSIONS.—
Length 2,661 mm. (104.6 in.).
Width 580 mm. (22.83 in.).
Width 620 mm. (24.41 in.).
Height 620 mm. (24.41 in.).

WEIGHT.—
Without tanks 230 kg. (507 lb.).

PERFORMANCE.—
Normal static thrust per chamber at S/L 1,500 kg. (3,300 lb.).
Max. static thrust at S/L (all chambers firing) 4,800 kg. (10,600 lb.).
Max. static thrust at 12,230 m. (40,100 ft.) (all chambers firing) 5,200 kg. (11,600 lb.).

CONSUMPTION.—
At S/L 18.8 kg./kg. s.t./hr. (18.8 lb./lb. st./hr.).

THE S.E.P.R. 65.

Fitted to the S.E. 212 Durandal, this rocket-engine has only a single small combustion chamber and gives a static thrust of 825 kg. (1,819 lb.) at 8,000 m. (26,250 ft.). It is used in the form of a pack, attached under the aircraft's fuselage, and its pumps are shaft-driven from the main turbojet engine of the aircraft on which it is fitted.

A development of the S.E.P.R. 65 will be fitted to the Dassault Mirage III interceptor.

WEIGHT.—
Without tanks and accessories 70 kg. (154 lb.).

THE S.E.P.R. 660.

This is a development of the S.E.P.R. 481, but is considerably neater in layout and is assembled on a truss beam for installation as a single self-contained unit. It exists in several forms, with one or two 1,500 kg. (3,300 lb.) s.t. chambers, two 750 kg. (1,650 lb.) s.t. chambers, or as a throttleable version with a power output of 750-1,500 kg. (1,650-3,300 lb.) s.t. as required.

Its main components and cycle of operation are similar to those of the S.E.P.R. 481. Mixture ratio of the nitric acid and furaline or Tx propellents is 2.7 : 1.

S.E.P.R. 660 engines have been fitted in Dassault Mystère IV and Mirage I and II aircraft.

DIMENSIONS.—
Length 2,800 mm. (110 in.).
Width 600 mm. (23.6 in.).
Height 300 mm. (11.8 in.).

WEIGHT.—
Without tanks 140 kg. (309 lb.) with single chamber, 160 kg. (353 lb.) with two chambers.

PERFORMANCE.—
Static thrust at S/L 1,500 kg. (3,300 lb.) or 3,000 kg. (6,600 lb.) depending on number of chambers.

THE S.E.P.R. 2020.

Few details of this liquid-propellent rocket motor are available, except that it is a single-chamber unit, running on nitric acid and either furaline or Tx propellents, and intended for use in missiles.

DIMENSIONS.—
Length 3,720 mm. (146.5 in.).
Height 670 mm. (26.4 in.).

WEIGHT.—
Including propellents 433 kg. (955 lb.).

PERFORMANCE.—
Static thrust at S/L 1,350 kg. (2,975 lb.) for 31 sec.

CONSUMPTION.—
At S/L 18.4 kg./kg. s.t./hr. (18.4 lb./lb. s.t. hr.).

S.E.P.R. SOLID-PROPELLENT ROCKET ENGINES.

Type	Static Thrust at S/L	Duration of Thrust in sec.	Consumption kg./kg. s.t./hr. lb./lb. s.t./hr.	Weight of Propellent	Weight of Motor	Total Weight	Specific Weight kg./kg. s.t. lb./lb. s.t.	Length	Diameter
S.E.P.R. 504	10,000 kg. (22,050 lb.)	4	18.0	208 kg. (458 lb.)	152 kg. (335 lb.)	360 kg. (793 lb.)	0.036	2,188 mm. (86.1 in.)	464 mm. (18.27 in.)
S.E.P.R. 505	10,000 kg. (22,050 lb.)	4.5	18.72	234 kg. (516 lb.)	168 kg. (370 lb.)	402 kg. (886 lb.)	0.0402	2,395 mm. (94.3 in.)	464 mm. (18.27 in.)
S.E.P.R. 5051	10,000 kg. (22,050 lb.)	4.2	18.9	220 kg. (485 lb.)	177 kg. (390 lb.)	397 kg. (875 lb.)	0.0397	2,275 mm. (89.6 in.)	464 mm. (18.27 in.)
S.E.P.R. 5052	13,500 kg. (29,760 lb.)	4	18.72	281 kg. (620 lb.)	187 kg. (412 lb.)	468 kg. (1,032 lb.)	0.0347	2,733 mm. (107.6 in.)	464 mm. (18.27 in.)
S.E.P.R. 5053	7,800 kg. (17,200 lb.)	4	18.72	163 kg. (359 lb.)	144 kg. (317 lb.)	307 kg. (676 lb.)	0.0394	1,870 mm. (73.6 in.)	464 mm. (18.27 in.)
S.E.P.R. 50531	7,800 kg. (17,200 lb.)	4	18.72	163 kg. (359 lb.)	161 kg. (355 lb.)	324 kg. (714 lb.)	0.0416	1,939 mm. (76.3 in.)	464 mm. (18.27 in.)
S.E.P.R. 681	10,000 kg. (22,050 lb.)	8	18	42 kg. (93 lb.)	42 kg. (93 lb.)	84 kg. (186 lb.)	0.084	1,962 mm. (77.2 in.)	236 mm. (9.30 in.)
S.E.P.R. 73	20,500 kg. (45,200 lb.)	4	18.72	427 kg. (941 lb.)	313 kg. (690 lb.)	740 kg. (1,631 lb.)	0.0361	2,800 mm. (110.2 in.)	637 mm. (25.08 in.)
S.E.P.R. 732	20,000 kg. (44,100 lb.)	4.45	18.9	468 kg. (1,032 lb.)	295 kg. (650 lb.)	763 kg. (1,682 lb.)	0.0381	2,780 mm. (109.4 in.)	637 mm. (25.08 in.)

SNECMA

SOCIÉTÉ NATIONALE D'ETUDE ET DE CONSTRUCTION DE MOTEURS D'AVIATION (SNECMA).

HEAD OFFICE: 150 BOULEVARD HAUSSMANN, PARIS (VIIIe).

WORKS: PARIS (BOULEVARD KELLERMANN), BILLANCOURT (SEINE), MELUN-VILLAROCHE (SEINE-ET-MARNE), SURESNES (SEINE) AND GENNEVILLIERS (SEINE).

President and Director-General: Henri Desbruères.

Administrative Director: M. Depallens.

Technical Director: H. Oestrich.

Director-Controller: Marcel Richer.

Commercial Director: André Esperet.

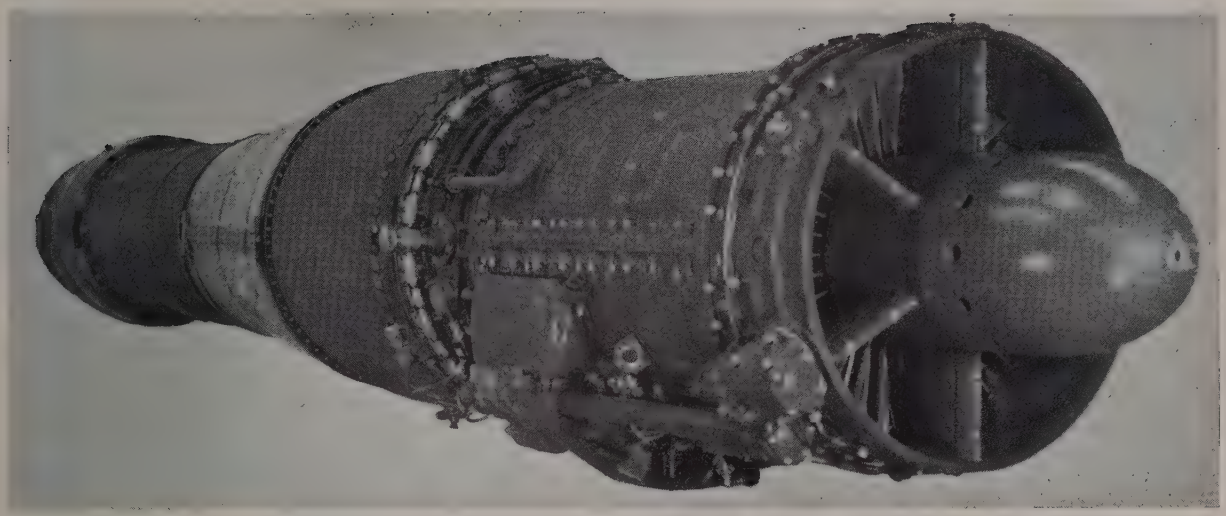
Director of External Relations: Maurice Roudil.

Director of Atomic Division: Raymond Marchal.

Personnel Manager: M. Dugue MacCarthy.

The Société Nationale d'Etude et de Construction de Moteurs d'Aviation (SNECMA) is devoting the major part of its activities to the development and series production of gas-turbine engines.

Manufacture and repair of turbojet engines is centred at the Kellermann works, and of internal combustion engines



The SNECMA Atar 8 turbojet engine (4,400 kg.=9,700 lb. s.t.).

at the Billancourt works. Ground and flight testing are done at Villaroche. The Gennevilliers works is engaged on forging and smelting. Prototypes are manufactured at the Suresnes works, which is also the research centre for the company.

All the S.O. 4050 Vautour, Dassault M.D. 452 Mystère II and Dassault Super Mystère IV B-2 aircraft now in production for the French Air Force are powered by SNECMA Atar engines. So are several of the latest prototypes and development aircraft, including the S.E. 5000 Baroudeur, Dassault Mirage III and Etendard IV, S.E. 212 Durandal, Nord 1405 Gerfaut II and Nord 1500 Griffon. The Leduc 0.22 also has an Atar as an auxiliary engine.

The latest SNECMA turbojets are the Atar 8 and 9, of which pre-production series are being built, and "all-steel" variants which will develop at least 6,000 kg. (13,225 lb.) s.t. and will power aircraft of Mach 3 performance which are now under development.

SNECMA is also working on equipment to improve the efficiency and versatility of its turbojets, including reheat, variable-area nozzles and jet-reversal for braking purposes.

Licences to manufacture the SNECMA cascade thrust reversal system have been acquired by the Aerojet-General Corporation in the United States and the Bristol Aeroplane Company in England.

SNECMA are also studying methods of controlling aircraft directionally at low speeds, when normal aerodynamic controls would be ineffective, by deviating the thrust of a turbojet engine. One technique is to vary the area of the jet exhaust by impinging on it at a predetermined angle a powerful auxiliary air jet; this dispenses with the need for moving components in contact with the hot gases. These experiments form part of the company's "Flying Atar" research programme of which a description appears under "SNECMA" in the French pages of the "Aircraft" section of this volume.

In addition, SNECMA has acquired European rights in Professor von Zborowski's patents for the annular wing coleopter type of aircraft, and is developing a ramjet engine to power high-speed aircraft of this type.

Its Atomic Division was formed in 1956 to study problems concerning the application of nuclear energy to the design of gas-turbine engines.

SNECMA continues its development in the field of pulsating jet units and brief details of the Escopette and Ecrevisse units are given hereafter. The Dutch Aviolanda company has acquired the licence to manufacture one of these pulsejets to power its AT-21 pilotless target aircraft.

THE SNECMA ATAR 8.

The Atar 8 is a large axial-flow turbojet engine which was exhibited in public for the first time at the 1955 *Salon de l'Aéronautique*.

The Atar 8 incorporates many refinements resulting from experience with earlier engines of the Atar series, and has nine compressor stages compared with eight on the Atar 101 Series and a two-stage turbine, compared with a single-stage on the earlier Series. It is in production to power the Dassault Etendard IV-M fighter.

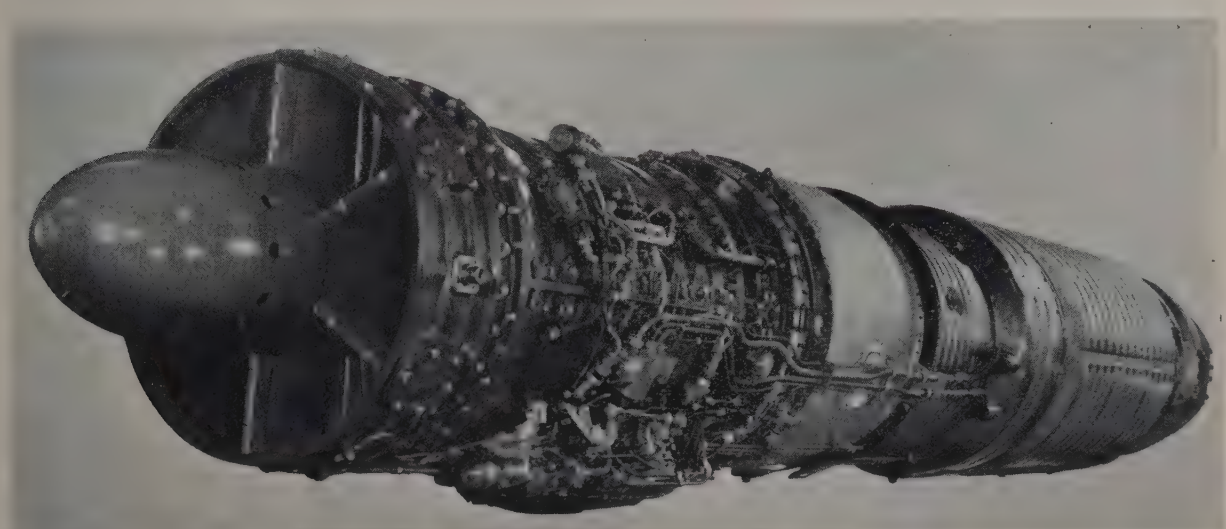
TYPE.—Axial-flow gas-turbine.

AIR INTAKE.—Annular type surrounding starter bullet. Six radial struts house the accessories bevel gear drive-shafts, starter feed ducts and lubricating oil outlet ducts. De-icing by circulation of hot air in casing, struts and hollow nozzle guide vanes.

COMPRESSOR.—Nine-stage axial-flow. Rotor drum made up of individual discs bolted to shaft. Shaft carried in ball bearing at front, roller bearings at centre and rear. Compressor casing is of light alloy in two halves. Forged and machined solid rotor and stator blades. Stator blades: rows 1, 2, 7-9 of steel, rows 3-6 of light alloy. Rotor blades: rows 1, 7-9 of steel, rows 2-6 of light alloy. All blades have prismatic roots which slide into corresponding slots in periphery of discs. Compression ratio 5.2 : 1. Air mass flow 68 kg./sec. (150 lb./sec.).

COMBUSTION CHAMBER.—Annular type with 20 direct-flow burners. Steel construction. Two starting pre-chambers and two igniters to ensure easy starting and relighting.

FUEL SYSTEM.—Twin-delivery type. Two-stage fuel pump: first stage of low-pressure centrifugal type, second stage of high-pressure gear type. Atar single-lever control regulating automatically r.p.m. and temperature. Max. fuel pressure 80 kg./cm.^{2} (1,140 lb./sq. in.).



The SNECMA Atar 9 turbojet with afterburner (6,010 kg.=13,250 lb. s.t.).



The SNECMA Atar 101G.2 turbojet with afterburner (4,400 kg.=9,700 lb. s.t.).

Fuel Grade.—Normeair 3405 (JP-0), 3407 (JP-4) or 3404 (JP-5).
Nozzle Guide Vanes.—Hollow air-cooled axial type, of steel.
Turbine.—Two-stage axial-flow type. Steel wheels splined to shaft, which is carried in roller bearings. Steel blades with fir-tree roots. First stage cooled by air carried through annular duct around shaft. Second stage cooled by air ducted through interior of shaft.
Jet Pipe.—Outer sheet steel casing with central cone. Variable-area nozzle with two clam-shell shutters, operated hydraulically.
Accessory Drives.—Two angled drive shafts, above and to port side of engine. Total available power 90 h.p.
Lubrication System.—Non-return system. Oil capacity 7 litres (1.54 Imp. gallons). Normal oil supply pressure 3.5 kg./cm.^{2} (50 lb./sq. in.).
Oil Specification.—Normeair 3513.
Mounting.—Two point suspension, one at front and one main central point.
Starting.—Compressed air starter inside intake central bullet.
Dimensions.—
Diameter 1,016 mm. (40 in.).
Length of engine 2,845 mm. (112 in.).
Length overall 4,600 mm. (181 in.).
Weight.—
Dry, less tailpipe 990 kg. (2,180 lb.).
Performance Ratings.—
Take-off 4,400 kg. (9,700 lb.) s.t. at 8,400 r.p.m.
Normal 3,765 kg. (8,300 lb.) s.t. at 8,300 r.p.m.
Max. cruising 3,370 kg. (7,430 lb.) s.t. at 8,150 r.p.m.
Consumptions.—
Fuel at take-off rating. 0.98 kg./kg. s.t./hr. (0.98 lb./lb. s.t./hr.).
Oil 0.70 litre/hr. (1.22 Imp. pints/hr.).

THE SNECMA ATAR 9.

The Atar 9 is identical with the Atar 8 except that it is fitted with an afterburner. It is in production to power the Dassault Mirage III-A fighter, following initial flight testing in a nacelle mounted under the wing-root of an S.E. 2060 Armagnac flying test-bed aircraft.
Dimensions.—
Diameter 1,067 mm. (42 in.).
Length overall 6,675 mm. (264 in.).
Weight.—
Dry 1,250 kg. (2,755 lb.).
Performance Ratings.—
Take-off 6,010 kg. (13,250 lb.) s.t. at 8,400 r.p.m.
Normal 5,350 kg. (11,800 lb./s.t. at 8,400 r.p.m.
Consumptions.—
Fuel at take-off rating 2.07 kg./kg. s.t./hr. (2.07 lb./lb. s.t./hr.).
Fuel at cruising power 0.97 kg./kg. s.t./hr. (0.97 lb./lb. s.t./hr.).
Oil 0.70 litres/hr. (1.22 Imp. pints/hr.).

THE SNECMA ATAR 101 SERIES.

The Atar 101 has been under development for a number of years, the earliest versions being the Atar 101A, 101B and 101C which developed 2,200 kg. (4,850 lb.), 2,400 kg. (5,290 lb.) and 2,800 kg. (6,170 lb.) s.t. respectively. These have been succeeded by the following production versions.

Atar 101D. 3,000 kg. (6,610 lb.) s.t. Fitted in production version of Dassault M.D. 452 Mystère II. No longer in production.

Atar 101DV. Similar to basic 101D but fitted with jet-deflection nozzle and arranged to function in a vertical attitude. For Atar Volant programme.

Atar 101E.3. 3,500 kg. (7,716 lb.) s.t. Installed in production S.O. 4050 Vautour and prototypes of S.E. 5003 Baroudeur, Nord 1500 Griffon and Leduc 0.22. In production.

Atar 101E.4. Development of 101E.3, with same dry weight, dimensions and specific fuel consumption, but developing 3,700 kg. (8,155 lb.) s.t. Completed two 100-hour type tests during 1956. Fitted to Dassault Etendard IV prototype.

Atar 101E.4A. Basically similar to E.4, but with new control system making it especially suitable for use in low-flying tactical fighter aircraft. 8% reduction in specific fuel consumption in cruising conditions.

Atar 101E.5. Similar to 101E.4, but with compressed air starter instead of electric starter.

Atar 101EV. Similar to basic 101E but fitted with jet-deflection nozzle and arranged to function in a vertical attitude. For Atar Volant programme.

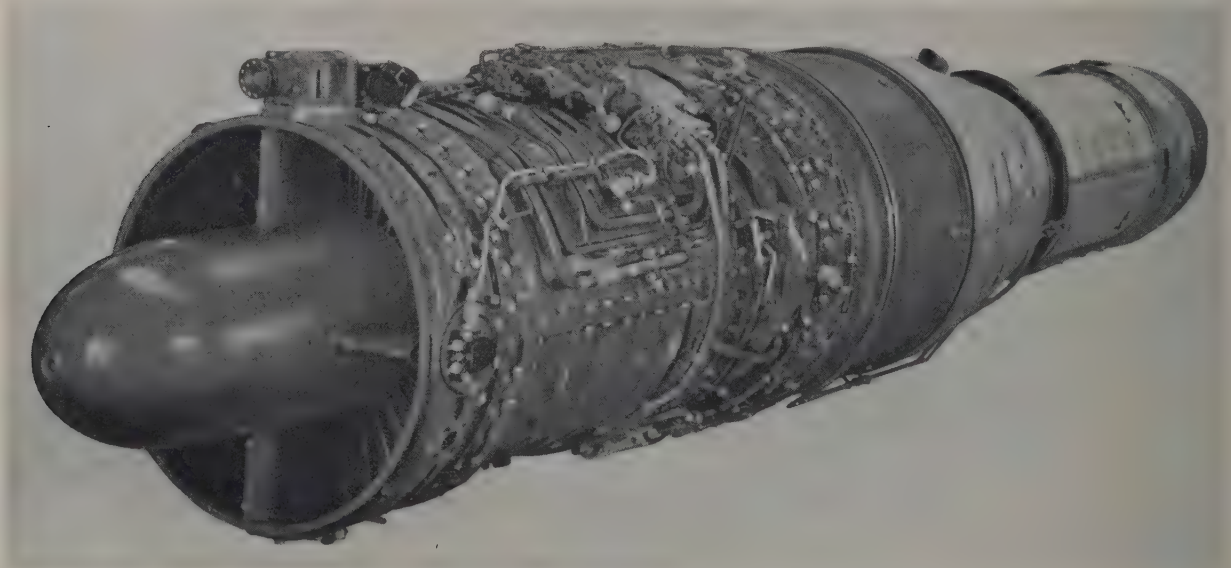
Atar 101F. Similar to 101D but fitted with afterburner. 3,800 kg. (8,360 lb.) s.t. with afterburning. Development version only. Powered Dassault Mystère IVB. Not built in series.

Atar 101G.2. Same as 101E but with afterburner. 4,400 kg. (9,700 lb.) s.t. with afterburning. Has Air-Equipement electric starter. Powers production Dassault Super-Mystère B-2 and prototypes of the S.E. 212 Durandal, Dassault Mirage III and Nord Gerfaut II. In production.

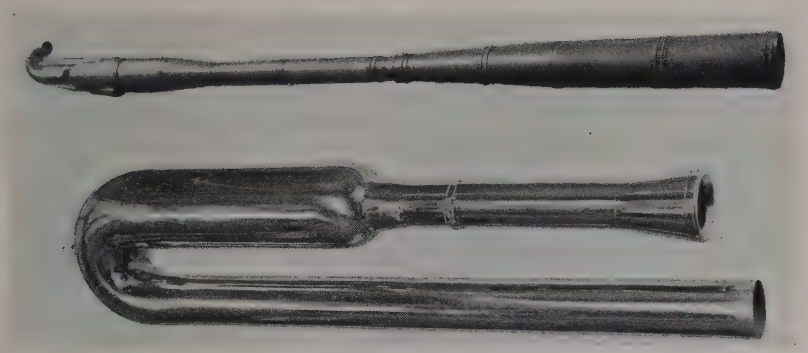
Atar 101G.3. Variant of 101G.2 developing 4,400 kg. (9,700 lb.) s.t. Main difference is that it has a Semca compressed air starter. In production to power Dassault Super-Mystère B-2.

The description which follows refers specially to the Atar 101E.

Type.—Axial-flow gas turbine with annular combustion chamber and single-stage turbine.
Compressor. — Eight-stage compressor. Rotor drum built up from individual discs, the rotor blades having prismatic roots which slide into corresponding slots in the periphery of the discs. Stub shafts flanged on each end of drum run in ball (forward) and roller (aft) bearings. Two-piece light alloy casing with inserted light metal guide vanes. Between compressor and combustion chamber is an entry casing which, apart from the ring of burners and fuel injectors, contains the rear compressor bearing and the drives for accessories and



The SNECMA Atar 101E.3 turbojet (3,500 kg.=7,716 lb. s.t.).



Two SNECMA pulse-jet units, the Escopette above and the Ecrevisse below.

oil pumps. Compression ratio 4.8 at 8,400 r.p.m. Air mass flow 59 kg./sec. (130 lb./sec.).

Combustion Chamber.—Sheet steel annular chamber with twenty single burners. Air from compressor is divided into primary and secondary air at the combustion ring, the primary air alone streaming through burners. The secondary air is ducted to enter the combustion chamber through the holes of the concentrically arranged inner annular liners. Fuel is injected downstream into primary air through ATAR 661 dual-flow injectors. The chamber includes also two starting pre-chambers, two starter burners, two resistance starting plugs.

Fuel System.—ATAR 534 fuel pump unit consisting of centrifugal pump, filter and high-pressure gear type pump. ATAR single-lever control regulating automatically r.p.m. and temperature.

Fuel Specification.—Turbofuel Normal AIR 3405 (density 0.810) or JP-4.

Nozzle Guide Vanes.—Air-cooled sheet steel nozzle guide vanes precede the turbine.

Turbine.—Single-stage turbine with fifty-nine blades of chrome-nickel alloy. Turbine drives the compressor *via* a movable tooth coupling and a large hollow shaft.

Jet Pipe.—Variable area type, with two clamshell shutters, moved by hydraulic servo-mechanism.

Accessory Drives.—Drive on compressor entry casing for permanent output of 21 mkg. for driving airframe accessories.

Lubrication.—Dry sump. One pressure pump and scavenge pumps. Centrifugal oil cleaner in oil return. Oil-fuel heat exchanger. Normal oil pressure 4 kg./cm.² (57 lb./sq. in.).

Starting.—Air Equipement 50.999 electric starter. High energy ignition system.

Dimensions (Atar 101E).—
Length 4,495 mm. (177 in.).
Diameter 920 mm. (36.2 in.).

Dimensions (Atar 101G with afterburner).—
Length 6,490 mm. (255 in.).
Diameter 920 mm. (36.2 in.).

Weight Dry (Atar 101E).—
882 kg. (1,945 lb.) with accessories and tail pipe.

Weight Dry (Atar 101G).—
1,230 kg. (2,712 lb.).

Performance Ratings (Atar 101E.3).—
Max. s.t. at S/L. 3,500 kg. (7,716 lb.) at 8,400 r.p.m.
Max. continuous at S/L. 2,800 kg. (6,173 lb.) at 8,050 r.p.m.
Cruising s.t. at S/L. 2,400 kg. (5,291 lb.) at 7,850 r.p.m.

Performance Ratings (Atar 101G.2).—
Max. s.t. at S/L. with afterburner 4,400 kg. (9,700 lb.) at 8,400 r.p.m.
Max. s.t. at S/L. without afterburner 3,400 kg. (7,495 lb.) at 8,400 r.p.m.
Max. continuous at S/L. 2,700 kg. (5,952 lb.) at 8,050 r.p.m.
Cruising s.t. at S/L. 2,300 kg. (5,070 lb.) at 7,850 r.p.m.

Consumptions (Atar 101E.3).—
Max. rating 1.05 kg./kg. s.t./hr. (1.05 lb./lb. s.t./hr.).
Max. continuous 1.01 kg./kg. s.t./hr. (1.01 lb./lb. s.t./hr.).
Cruising 1.00 kg./kg. s.t./hr. (1.00 lb./lb. s.t./hr.).

Consumption (Atar 101G).—
Max. rating with afterburning approx. 2.0 kg./kg. s.t./hr. (2.0 lb./lb. s.t./hr.).
Max. rating without afterburning 1.11 kg./kg. s.t./hr. (1.11 lb./lb. s.t./hr.).
Max. continuous 1.07 kg./kg. s.t./hr. (1.07 lb./lb. s.t./hr.).
Cruising 1.07 kg./kg. s.t./hr. (1.07 lb./lb. st./hr.).

SNECMA PULSE-JETS.

SNECMA has been engaged since 1950 in the development of pulse-jet units which are devoid of all valves or other moving parts, being of the resonant-duct type.

Although they have no moving parts, they are able to develop power while static, unlike a ramjet engine. And, despite their low-pressure cycle, they have a specific fuel consumption of the same order as that of a turbojet engine with afterburner.

The pulse-jets incorporate automatic induction and ignition techniques developed by SNECMA, and have been produced in various forms, ranging in power from 10 kg. (22 lb.) to 200 kg. (4,400 lb.) s.t. each. The first was the Escopette (Carbine) with a power of 10 kg. (22 lb.) s.t., followed by the Ecrevisse (Crayfish) in which the duct is bent double through 180°.

So far these pulse-jets have been utilised mainly as power-plants for target aircraft, but their use as rotor-tip propulsion units for helicopters is being studied. They are also being developed as static power-plants, particularly for agricultural applications in the form of insecticide-spraying equipment.

TURBOMECA

SOCIÉTÉ TURBOMECA.

Head Office and Works: Bordes (Basses-Pyrénées).

Paris Office: 1, Rue Beaujon, Paris 8e.

President and Director General: J. R. Szydlowski.

The Société Turbomeca was formed in 1938 by MM. Szydlowski and Planiol to develop blowers, compressors and turbines for aeronautical use.

In 1947 the company began the development of gas-turbines of low power for driving aircraft auxiliaries and for aircraft propulsion.

The range of Turbomeca gas-turbine engines now includes the Gabizo (1,100 kg.=2,420 lb. s.t.), Gourdon (660 kg.=1,450 lb. s.t.), Gourdon II (700 kg.=1,543 lb. s.t.), Marboré II (400 kg.=880 lb. s.t.), Arbizon (250 kg.=550 lb. s.t.) and Palas (160 kg.=353 lb. s.t.) turbojet engines; the Marcadau (400 s.h.p.) and Astazou (320 h.p.) turboprops; the Bastan (750 s.h.p.), Turmo (270-750 s.h.p.), and Artouste (400-650 s.h.p.) shaft turbines; and the Autan, Tramontane and Palouste air compressors.

Both the Palas and Marboré turbojets are installed in a number of aircraft. The Marboré II powers, among other aircraft, the Fouga 170 Magister twin-engined trainer which is in production for the French and Federal German Air Forces, the Fouga 175 Esquif of the French Navy, and the Morane-Saulnier 760. The 1,000th production Marboré II was delivered at the end of January, 1958.

The Marcadau turboprop is fitted in the prototype Morane-Saulnier Epervier general purpose military aircraft. Four Turmo II turboprops power the Breguet 940 experimental "blown-wing" aircraft.

The shaft turbine engines are suitable for many applications where useful horse-power is required at a single mechanical coupling. The Artouste II engine drives the rotor of the Sud-Aviation 3130 Alouette II helicopter.

The compressed air generators are also suitable for many applications, including helicopter power-drives, starting power for large gas-turbines, etc. The Palouste supplies propulsive air to the rotor-tip jets of the S.O. 1221 Djinn helicopter, one of which set up an international helicopter altitude record of 8,482 m. (27,828 ft.) on March 22, 1957.

A remarkable degree of interchangeability exists among the whole range of Turbomeca engines.

Licences for Turbomeca gas-turbines have been negotiated with the Blackburn and General Aircraft, Ltd. in England, and the Continental Aviation & Engineering Corporation in the United States.

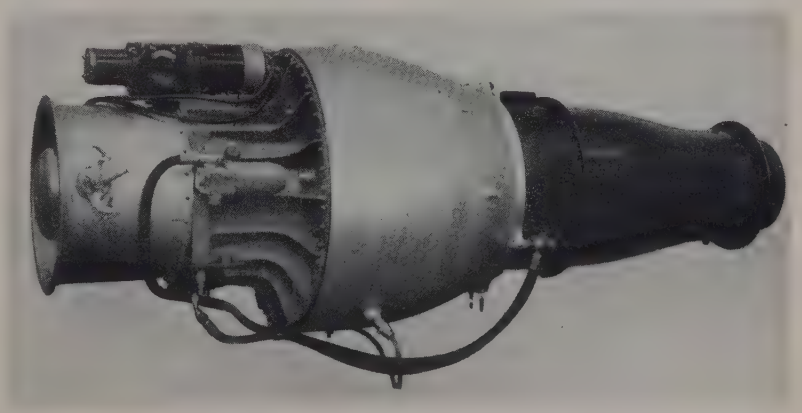
THE TURBOMECA PALAS.

Type.—Turbojet with single-stage compressor, annular combustion chamber with rotating fuel delivery ring and single-stage turbine.

Compressor.—Single-stage centrifugal compressor. Compression ratio 3.95 : 1. Air mass flow 3.2 kg./sec. (7.05 lb./sec.).

Combustion Chamber.—Annular, with rotary fuel injection. The fuel ring, around the periphery of which are a number of vents, is attached to the shaft connecting compressor and turbine discs and revolves with it. Fuel is fed into the inside of the ring and is vented by centrifugal force, being vaporised in the process. Fuel delivery at low thrust settings regulated by by-pass valve.

Turbine.—Single-stage single-piece turbine with 31 blades preceded by stator with twenty air-cooled vanes. Turbine r.p.m.



The Turbomeca Palas turbojet engine.

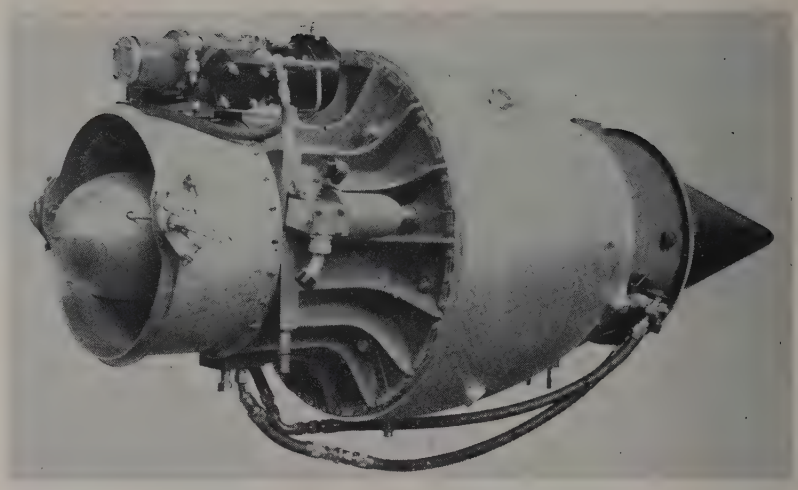
35,000. Gas temperature before turbine 700°C., after turbine 600°C.
FUEL PUMP.—Turbomeca. Maximum pressure 4 kg./cm.² (57 lb./sq. in.).
FUEL.—Kerosene (Air 3405).
OIL GRADE.—Air 3512.
STARTER.—Air Equipement 24 volt electric or compressed-air starter. Two igniter plugs.
MOUNTING.—Three mounting pads, two on compressor casing and one on underside of combustion chamber.
DIMENSIONS.—
Length 1,200 mm. (47.25 in.).
Diameter 405 mm. (16 in.)
WEIGHT DRY.—
72 kg. (159 lb.).
PERFORMANCE RATINGS.—
Max. T.O. (static) 160 kg. (353 lb.) at 34,000 r.p.m.
Normal thrust 130 kg. (287 lb.).
FUEL CONSUMPTIONS.—
At max. T.O. 1.17 kg./kg. s.t./hr. (1.17 lb./lb. s.t./hr.).
At normal thrust 1.13 kg./kg. s.t./hr. (1.13 lb./lb. s.t./hr.).

THE TURBOMECA ARBIZON.

The Arbizon, introduced in 1955, is a development of the Palas with a two-stage compressor, consisting of an axial stage followed by a centrifugal stage, and a two-stage turbine.
DIMENSIONS.—
Diameter 405 mm. (16 in.).
WEIGHT DRY.—
104 kg. (229 lb.).
PERFORMANCE RATINGS.—
Max. T.O. (static) 250 kg. (550 lb.) at 34,000 r.p.m.
Max. continuous 200 kg. (440 lb.).
FUEL CONSUMPTION.—
0.91 kg./kg. s.t./hr. (0.91 lb./lb. s.t./hr.).

THE TURBOMECA MARBORÉ II.

TYPE.—Turbojet with single-stage compressor, annular combustion chamber and single-stage turbine.
AIR INTAKE.—Annular sheet metal nose intake bolted to front of light alloy compressor casing.
COMPRESSOR.—Single-sided impeller machined from two alloy forgings, shrunk on steel shaft and locked and dowelled to maintain alignment. Externally-finned light alloy compressor casing supports front ball-bearing for rotating assembly in a central housing supported by three streamlined struts. This housing also contains gears for accessory drives. Compression ratio (at maximum r.p.m.) 3.85 : 1. Mass air flow 8 kg./sec. (17.64 lb./sec.).
COMBUSTION CHAMBER.—Composed of inner and outer sheet metal casings, forming annular flame tube. Air from compressor passes through both radial and axial diffuser vanes and divides into three main flows, two primary for combustion and one secondary. Two primary flows enter combustion zone from opposite ends of chamber, the rear stream through turbine nozzle guide vanes which it cools. Secondary flow enters through outer casing for dilution and cooling of combustion gases. Two torch igniters.
FUEL SYSTEM.—Fuel, pumped through hollow impeller shaft, is fed to combustion zone by rotating injector disc around periphery of which are number of vents which act as nozzles. Fuel is vented by centrifugal force, being atomised in the process. Fuel delivery at low thrust settings regulated by by-pass valve.



The Turbomeca Marboré II turbojet engine.

FUEL GRADE.—Air 3405 (JP-1).
NOZZLE GUIDE VANES.—Twenty-five hollow sheet steel guide vanes cooled by part of primary combustion air.
TURBINE.—Single-stage turbine with thirty-seven blades integral with steel disc. Bolted to main shaft and tail shaft, latter supported by rear roller bearing for rotating assembly.
JET PIPE.—Inner and outer sheet metal casings, latter supported by three hollow struts. Inner tapered casing extends beyond end of outer casing to induce airflow through struts to cool rear main bearing and inner casing.
ACCESSORY DRIVES.—Gear casing in central compressor housing with drives for fuel and oil pumps. Connecting shaft to underside of accessories gear case above compressor casing. Accessories include tachometer generator and electric starter. Take-off (4 h.p. continuous) for remotely-driven accessory box.
LUBRICATION SYSTEM.—Pressure type. Single gear-type pump serves front gear casing, two main bearings and r.p.m. governor. Three scavenge pumps return bearing oil to tank *via* cooler. Normal oil pressure 2.8 kg./cm.² (40 lb./sq. in.).
OIL SPECIFICATION.—Air 3512.
MOUNTING.—Four points, with Silentbloc rubber mountings, two at front and two at rear.
STARTING.—Air Equipement 24-volt electric starter or compressed-air starter. Two Turbomeca igniter plugs.
DIMENSIONS.—
Length 1,566 mm. (51.65 in.).
Width 567 mm. (22.3 in.).
Height 288 mm. (11.4 in.).
WEIGHT.—
145 kg. (320 lb.).
PERFORMANCE RATINGS.—
Take-off (static) 400 kg. (880 lb.) at 22,600 r.p.m.
Max. continuous 360 kg. (795 lb.).
CONSUMPTIONS.—
Fuel (T.O.) 1.15 kg./kg. thrust/hr. (1.15 lb./lb. s.t./hr.).
Fuel (max. cont.) 1.09 kg./kg. thrust/hr. (1.09 lb./lb. s.t./hr.).

THE TURBOMECA GOURDON.

The Gourdon, introduced in 1955, is a centrifugal-flow turbojet engine of typical Turbomeca configuration, developed from the Marboré. It has the following characteristics.
DIMENSIONS.—
Length 1,900 mm. (74.8 in.).
Diameter 570 mm. (22.45 in.).
WEIGHT DRY (Gourdon I).—
172 kg. (380 lb.).
WEIGHT DRY (Gourdon II).—
181 kg. (400 lb.).
PERFORMANCE RATING (Gourdon I).—
Max. T.O. (static) 660 kg. (1,450 lb.) at 21,500 r.p.m.
Max. continuous 525 kg. (1,150 lb.).
PERFORMANCE RATINGS (Gourdon II).—
Max. T.O. (static) 700 kg. (1,543 lb.) at 21,500 r.p.m.
Max. continuous 560 kg. (1,235 lb.) s.t.
FUEL CONSUMPTIONS (Gourdon I).—
At max. T.O. 1.02 kg./kg. s.t./hr. (1.02 lb./lb. s.t./hr.).
At max. continuous 0.96 kg./kg. s.t./hr. (0.96 lb./lb. s.t./hr.).
FUEL CONSUMPTION (Gourdon II).—
At max. continuous 0.98 kg./kg. s.t./hr. (0.98 lb./lb. s.t./hr.).

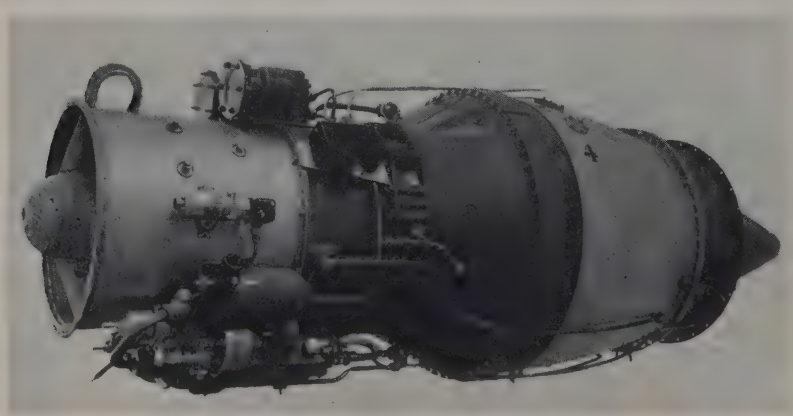
THE TURBOMECA GABIZO.

The Gabizo, a development of the Marboré II, was designed to meet the French Air Ministry requirements for an engine to power the light-weight fighter aircraft under development for the new French defence programme. It has a two-stage compressor, consisting of an axial stage followed by a centrifugal stage, with an annular combustion chamber, single-stage turbine and Nord afterburner with two-position nozzle. Mass flow is approximately 19 kg. (42 lb.) sec. and pressure ratio is 5.2 : 1.

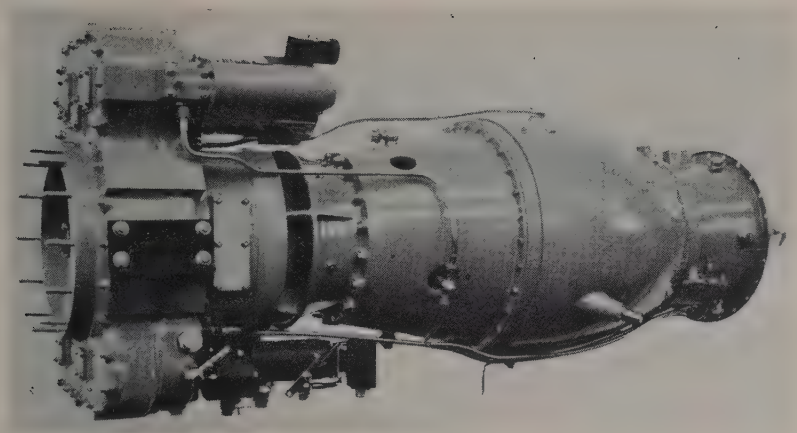
Two Gabizos were fitted on the wing-tips of the Sud-Aviation Trident II which set up several rate of climb and altitude records in the Spring of 1958.
DIMENSIONS.—
Length 2,083 mm. (81.9 in.).
Length, with afterburner 3,610 mm. (142.2 in.).
Diameter 670 mm. (26.5 in.).
WEIGHT DRY.—
265 kg. (584 lb.).
With afterburner 440 kg. (970 lb.).
PERFORMANCE RATINGS.—
Max. T.O. (static) 1,100 kg. (2,420 lb.) at 17,500 r.p.m.
Max. continuous 880 kg. (1,940 lb.).
Max. T.O. with afterburner 1,540 kg. (3,395 lb.).
FUEL CONSUMPTIONS.—
At max. T.O. 1.04 kg./kg. s.t./hr. (1.04 lb./lb. s.t./hr.).
At max. continuous 0.96 kg./kg. s.t./hr. (0.96 lb./lb. s.t./hr.).

THE TURBOMECA MARCADAU.

The Marcadau is the Artouste II turbine with an airscrew reduction gear of the spur type. The reduction gear ratio is 1 : 2.332. The centre-line of the airscrew shaft is 130 mm. (5.1 in.) below the turbine shaft centre-line.



The Turbomeca Gabizo turbojet engine.



The Turbomeca Artouste III shaft turbine engine.

DIMENSIONS.—
Length 1,390 mm. (54.8 in.).
Height 545 mm. (21.5 in.).
Width 452 mm. (17.8 in.).
WEIGHT (without airscrew).—
139 kg. (307 lb.).
PERFORMANCE.—
T.O. output 400 h.p. at 2,500 shaft r.p.m. plus 35 kg. (77 lb.) residual thrust.
Max. climb output 360 h.p. at 2,500 shaft r.p.m. plus 32 kg. (70 lb.) residual thrust.
Max. continuous output 320 h.p. at 2,500 shaft r.p.m. plus 30 kg. (66 lb.) residual thrust.

THE TURBOMECA ASTAZOU.

The Astazou turboprop is one of a completely new range of Turbomeca engines, incorporating the experience gained with earlier series and making use of new design techniques. First displayed at the 1957 Paris *Salon*, it has an extremely small gas-producer section and drives a two-blade variable-pitch airscrew.

The two-stage compressor consists of an axial stage followed by a centrifugal stage, with an annular combustion chamber and multi-stage turbine. Accessories are mounted on the rear of the main intake casting.

DIMENSIONS.—
Length approx. 1,818 mm. (71.6 in.).
Diameter 460 mm. (18.1 in.).
DRY WEIGHT.—
110 kg. (245 lb.).
PERFORMANCE RATING.—
Max. T.O. 320 h.p. at 40,000 r.p.m.
FUEL CONSUMPTION.—
0.30 kg. (0.66 lb.) per h.p./hr.

THE TURBOMECA ARTOUSTE IIB.

The Artouste is a shaft turbine. The two-stage turbine uses part of the available power to drive the compressor, the remaining power being free to drive a power take-off shaft.

TYPE.—Gas-turbine with centrifugal compressor, an annular combustion chamber and a two-stage turbine.
COMPRESSOR.—Single-stage centrifugal compressor. Compression ratio at 33,000 r.p.m. at S/L 3.55 : 1. Air mass flow 3.0 kg./sec. (6.6 lb./sec.) at 33,000 r.p.m. at S/L.
COMBUSTION CHAMBER.—Annular type as in Palas.
FUEL.—AIR 3405 turbofuel. Normal aviation gasoline for starting.
OIL.—AIR 3512 (mineral) oil.
TURBINE.—Two-stage axial type. 1st stage 20 stator blades and 27 rotor blades. 2nd stage 34 stator blades and 25 rotor blades.
JET PIPE.—Fixed type. Diameter of diffuser exit 310 mm. (12.2 in.). Exhaust gas speed 100 m./sec. (328 ft./sec.) maximum. Exhaust gas temperature 550°C. maximum.
STARTING.—Labavia 2,500-watt starter. Two Turbomeca igniter plugs.
DIMENSIONS.—
Length 1,348 mm. (53.1 in.).
Height 545 mm. (21.5 in.).
Width 388 mm. (15.2 in.).
WEIGHT.—
145 kg. (320 lb.).
PERFORMANCE.—
Max. output (5 min.) 400 s.h.p. at 34,000 turbine r.p.m. plus 35 kg. (77 lb.) residual thrust at S/L.
Max. continuous output 330 s.h.p. at 34,000 turbine r.p.m. plus 30 kg. (66 lb.) residual thrust at S/L.
FUEL CONSUMPTIONS.—
At max. output 182 kg. (401 lb.) per hour.
At max. continuous output 158 kg. (348 lb.) per hour.

THE TURBOMECA ARTOUSTE III.

This is a developed version of the Artouste II which also exists with reduction gear for co-axial airscrews, in which form it develops 600 s.h.p.

WEIGHT DRY.—
144 kg. (317 lb.).
PERFORMANCE.—
Max. output 550 s.h.p.
FUEL CONSUMPTION.—
180 kg./hr. (397 lb./hr.).

THE TURBOMECA BASTAN.

One of the new generation of Turbomeca engines, first shown with the Astazou turboprop at the 1957 Paris *Salon*, the Bastan is a turboprop engine which has been chosen to power the production Morane-Saulnier Epervier, S.E. 116 Voltigeur and other new aircraft. It is being flight tested initially in a converted Beechcraft Super 18 airframe.

The Bastan has a two-stage compressor, consisting of an axial stage followed by a centrifugal stage, with an annular combustion chamber and multi-stage turbine. It drives a three-blade variable-pitch airscrew of 2.75 m. (9 ft.) diameter.

DIMENSIONS.—
Length 1,545 mm. (60.9 in.).
Diameter 550 mm. (21.6 in.).
DRY WEIGHT.—
Without airscrew 212 kg. (467 lb.).
PERFORMANCE RATING.—
Max. T.O. 750 s.h.p. at 33,500 r.p.m.
FUEL CONSUMPTION.—
0.33 kg. (0.73 lb.) per h.p./hr.

THE TURBOMECA TURMO.

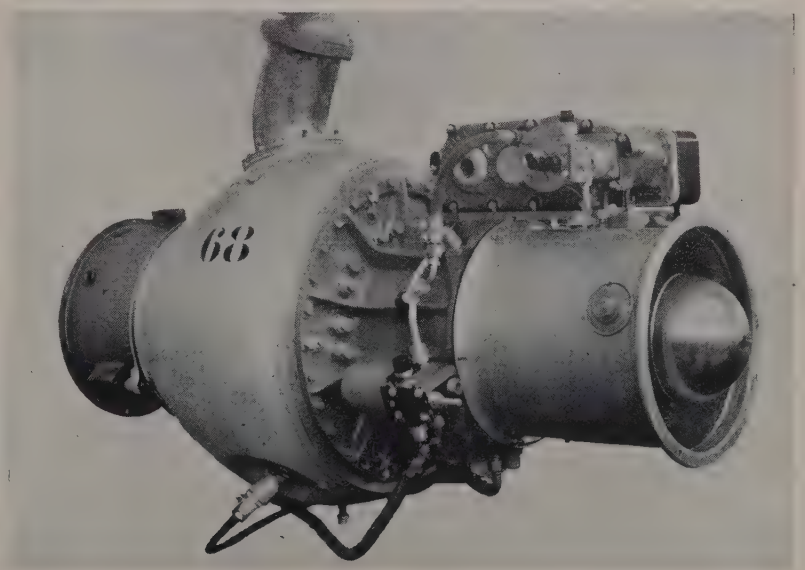
The Turmo is a shaft turbine which consists of a gas generator, comprising a compressor, combustion chamber and a single-stage turbine, the exhaust from which drives a "free" single-stage turbine. The "free" turbine drives the output shaft through a reduction gear. This kind of unit has the advantage of a very high starting torque.

Compression ratio of the Turmo II is 3.3 : 1 and air mass flow 3.2 kg. (7.05 lb.) sec.

DIMENSIONS (Turmo I).—
Length 1,146 mm. (45.2 in.).
Width 700 mm. (27.6 in.).
Height 550 mm. (21.7 in.).
DIMENSIONS (Turmo II).—
Length 1,232 mm. (48.5 in.).
Width 550 mm. (21.7 in.).
Height 589 mm. (23.2 in.).
DIMENSIONS (Turmo III).—
Length 1,663 mm. (65.5 in.).
Width 798 mm. (31.4 in.).
Height 565 mm. (22.25 in.).
WEIGHT (Turmo I).—
240 kg. (530 lb.).
WEIGHT (Turmo II).—
Less reduction gear 145 kg. (320 lb.).
WEIGHT (Turmo III).—
195 kg. (430 lb.).
PERFORMANCE (Turmo I).—
Max. shaft output 270 h.p. at 3,500 r.p.m.
Max. continuous shaft output 230 h.p. at 3,000 r.p.m.
Gas generator speed (max. continuous) 33,750 r.p.m.
PERFORMANCE (Turmo II—without gearbox).—
Max. shaft output 400 h.p. at 34,500 compressor r.p.m.
Max. continuous shaft output 360 h.p. at 24,000 r.p.m.
Gas generator speed (max. continuous) 33,000 r.p.m.
PERFORMANCE (Turmo III).—
Max. shaft output 750 h.p. at 6,000 r.p.m.
FUEL CONSUMPTIONS.—
At max. continuous output (Turmo I) 112 kg. (247 lb.) per hour.
At max. continuous output (Turmo II) 170 kg. (375 lb.) per hour.
At max. continuous output (Turmo III) 263 kg. (580 lb.) per hour.

THE TURBOMECA PALOUSTE IV.

The Palouste is a turbo-generator which incorporates an oversize impeller in its compressor so that a proportion of the air may be taken from the engine after compression but before it enters the combustion chamber.



The Turbomeca Palouste IV turbo-compressor.

The combustion chamber, turbine, accessory drives, etc. of the Palouste are similar to those of the Artouste.

After completing successfully a 150-hour Type Test in 1956, a Palouste IV was kept running for two further periods of 150 hours as an endurance test. In all, it completed 502 hours of running without fault.

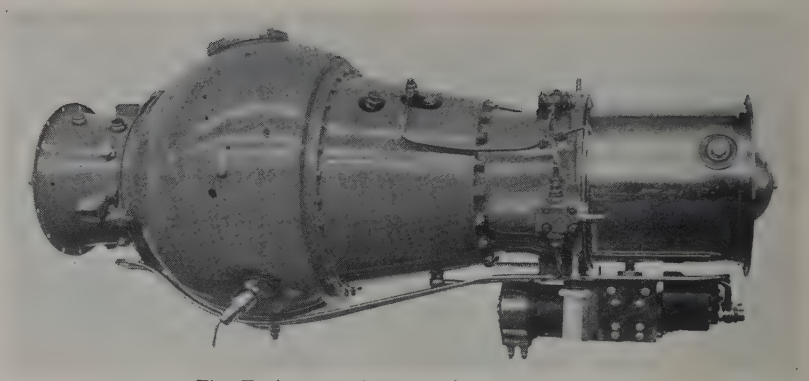
This engine powers the S.O. 1221 Djinn helicopter.

DIMENSIONS.—
Length 1,233 mm. (48.5 in.).
Height 500 mm (19.7 in.).
Width 475 mm. (18.7 in.).
WEIGHT (with accessories).—
90 kg. (198 lb.).
PERFORMANCE (at ambient temperature of up to 45°C.).—
Air delivery (3.75 compression ratio) 1,140 gr./sec. (2.5 lb./sec.) at 34,000 r.p.m.
FUEL CONSUMPTION.—
110 kg./hr. (243 lb./hr.).

THE TURBOMECA AUTAN II.

The Autan, introduced in 1955, is a development of the Palouste, with a two-stage (axial followed by centrifugal) compressor. It has the following characteristics.

DIMENSION.—
Diameter 405 mm. (16 in.).
WEIGHT (with accessories).—
113 kg. (249 lb.).



The Turbomeca Autan turbo-compressor.

PERFORMANCE.—
Air delivery (5.1 compression ratio) 1,350 gr./sec. (3 lb./sec.) at 34,000 r.p.m.
FUEL CONSUMPTION.—
160 kg./hr. (353 lb./hr.).

THE TURBOMECA TRAMONTANE.

First shown at the 1957 Paris *Salon*, the Tramontane is a turbo-generator, or air compressor, in which air is supplied from two outlets, one on each side of the main casing. It has a single centrifugal compressor of Marboré size, an annular combustion chamber and two-stage turbine. Mass flow is approximately 7.56 kg. (16.7 lb.) sec. and pressure ratio 3.5 : 1.

DIMENSIONS.—
Length without tailcone 1,200 mm. (47.3 in.).
Diameter 577 mm. (22.75 in.).
DRY WEIGHT.—
168 kg. (370 lb.).
PERFORMANCE.—
Air delivery 2.5 kg. (5.5 lb.) sec. at 22,600 r.p.m.
FUEL CONSUMPTION.—
310 kg. (680 lb.) hr.

GERMANY

THE GERMAN FEDERAL REPUBLIC

BMW

BMW TRIEBWERKBAU G.m.b.H.

HEAD OFFICE AND WORKS: 665, DACHAUERSTRASSE, MUNICH.

Managing Directors: Ferdinand Brandner and Hugo F. Krambeck.

The BMW Triebwerkbau G.m.b.H. is a wholly-owned subsidiary of the Bayerische Motoren Werke A.G. of Munich, manufacturers of the well-known BMW motorcycles and automobiles.

The BMW aero-engine production centre at Munich-Allach escaped serious damage during the war and is available for production. Facilities include more than 50 engine test-beds, a power station and an extensive fuel supply system.

In September, 1957 the BMW Studiengesellschaft für Triebwerkbau G.m.b.H. was merged with the BMW Triebwerkbau G.m.b.H. and now constitutes the Research and Development Group within the company. Its staff includes many of the technicians who designed and engineered the wartime series of BMW piston, gas-turbine and rocket engines. At present, the research team is working on projects in the gas-turbine field.

In November, 1957 the BMW Triebwerkbau concluded a licence agreement with the Lycoming Division, AVCO Manufacturing Corporation of Williamsport, Pa., whereby BMW acquired the rights to build the GO-480-B1A6 and to overhaul and service all other models of the Lycoming piston engine series in the Federal German Republic. Aircraft types in which the GO-480 engine is installed include the Dornier Do 27 and Piaggio P.149D.

In 1958 BMW Triebwerkbau purchased an option to build the Bristol Orpheus lightweight turbojet engine under licence.

In addition, BMW is starting the repair and servicing of Orenda 10 and 14 turbojet engines installed in the Canadair Sabre Mk. 5 and 6 which are in service with the German Air Force. This work is being done under a technical assistance agreement with Orenda Engines Ltd.

DAIMLER-BENZ

DAIMLER - BENZ AKTIENGESELLSCHAFT.

HEAD OFFICE AND WORKS: STUTTGART-UNTERTÜRKHEIM.

This famous company, which is the descendant of the oldest automobile factory in the world, has been building aero-engines since the early years of this century when it supplied the powerplants for Count Zeppelin's airships. Its later products culminated in the DB 601, 603, 605, 606 and 610 high-powered inverted liquid-cooled piston-engines which were fitted in a high proportion of Germany's wartime aircraft.

The company's large works at Stuttgart have been re-built and are at present engaged on producing engines for road vehicles. No aircraft engine production has yet been undertaken; but in April, 1957, Daimler-Benz signed an export agreement with three U.S. companies, including the Curtiss-Wright Corporation, one section of which gives Daimler-Benz the licence to service, and eventually build, Curtiss-Wright aircraft engines in Germany.

HEINKEL

ERNST HEINKEL AKTIENGESELLSCHAFT.

HEAD OFFICE AND WORKS: HELLMUTH - HIRTH - STRASSE, STUTTGART - ZUFFENHAUSEN.

President and General Manager: Alfred Klein.

Vice-President (Administration): Hans Nürnberger.

Director (Sales): F. W. Seekatz.

Chief Engineer (Development): Robert Ruprecht.

Chief Engineer (Production); Hans Niedermeier.

The Ernst Heinkel Aktiengesellschaft had its origin in the former Ernst Heinkel Flugzeugwerke of Warnemünde and Rostock, which began development of gas-turbine engines in 1936 and built the He S 3B turbojet which powered the Heinkel He 178, the first jet-propelled aeroplane to fly, on August 27, 1939.

After 1945, only the plant at Stuttgart-Zuffenhausen was left of the former works at Rostock, Berlin-Oranienburg, Berlin-Waltersdorf, Wien-Schwechat and Jenbach/Tirol. The development and production of small engines in the 50-1,100 cc. class was undertaken at this works, together with the production of motor scooters and three-wheeled vehicles.

To supplement these activities the company is now servicing and repairing the Turbomeca Marboré II engines of the the Fouga Magister trainers serving with the German Air Force.

THE GERMAN DEMOCRATIC REPUBLIC

Development and production of aero-engines in East Germany is, like the construction of aircraft, carried out in a state-owned factory under the direction of the :—

VERWALTUNG DER LUFTFAHRTINDUSTRIE.

HEADQUARTERS: PIRNA/ELBE.

The aero-engine factory at Chemnitz was opened in 1954 and concentrated initially on production under licence of the 1,900 h.p. Soviet ASh-82T piston-engine. This engine powers the Il-14P airliners that are being built under licence in East Germany. A description of the ASh-82T engine will be found in the Piston-engine Section under "Soviet Union".

At the same time, development was started of the Type 014 turbojet engine to power the nationally-designed Type 152 jet transport. Brief details of this engine are given hereafter.

THE TYPE 014.

Intended specifically to power the Type 152 jet transport, the Type 014 turbojet is a purely civil engine with the emphasis on low specific fuel consumption. It is arranged for single-lever control.

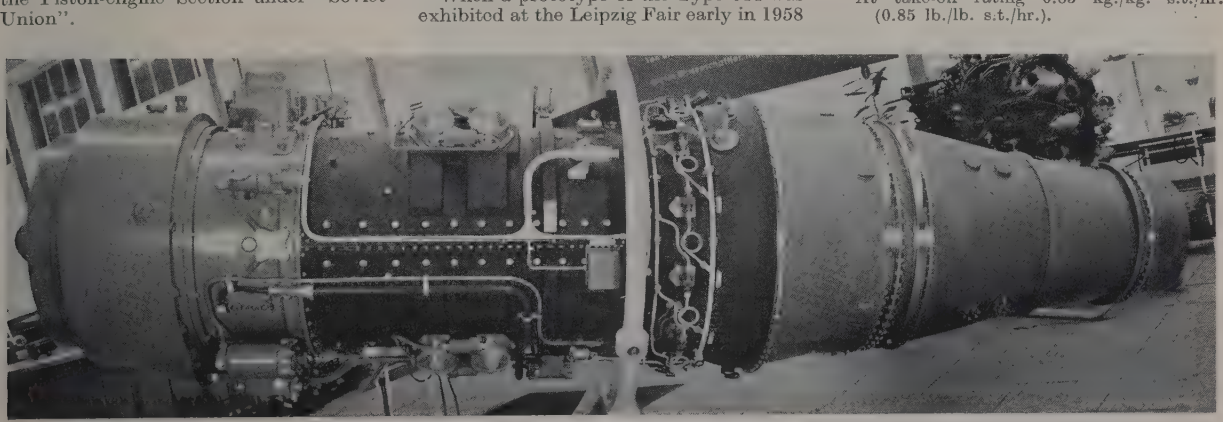
It has a twelve-stage axial-flow compressor, annular combustion chamber with twelve burners, and two-stage turbine. The electric starter is mounted in the centre of the intake casing. Air mass flow is 50 kg. (110 lb.)/sec.

When a prototype of the Type 014 was exhibited at the Leipzig Fair early in 1958 it was announced that the efficiency and reliability of the engine resulted in part from the use of components and materials that were already proven by use in other turbines, and that it was already known to be suitable for operation in all temperatures from —60°C. to +60°C. This appears to confirm the belief that the Type 014 is derived from the Junkers Jumo 012 turbojet, the development of which was continued in Russia after the war.

DIMENSIONS.—
Diameter 980 mm. (38.58 in.).
Length 4,100 mm. (161.42 in.).

PERFORMANCE RATING.—
Take-off power 3,150 kg. (6,945 lb.) s.t.

FUEL CONSUMPTION.—
At take-off rating 0.85 kg./kg. s.t./hr. (0.85 lb./lb. s.t./hr.).



The Type 014 turbojet engine (3,150 kg.=6,945 lb. s.t.), four of which power the Type 152 airliner.

ITALY

FIAT

FIAT, SOCIETÀ PER AZIONI.

AERO-ENGINE WORKS: VIA NIZZA 312, TURIN.

Full details of the present organisation of the Fiat Company are given in the "Aeroplane" Section of this work.

The Fiat Company was incorporated in 1899 and built its first aero-engines in 1908.

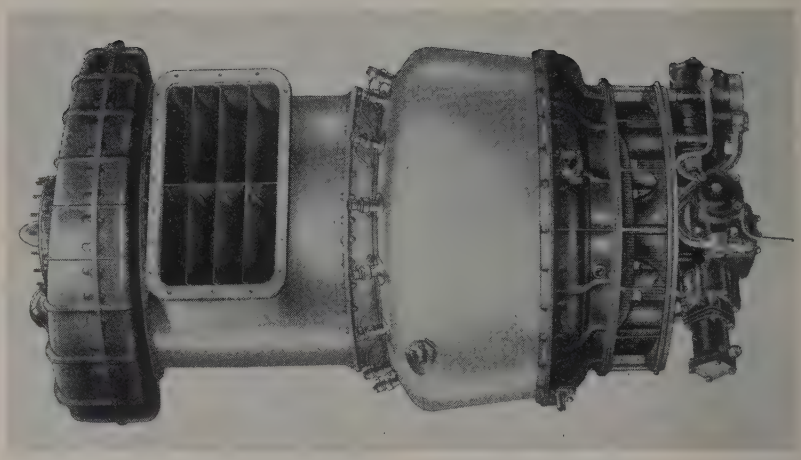
Fiat entered the gas-turbine field after the last war, by undertaking first the licence-production of the de Havilland Ghost centrifugal-flow turbojet engine and then, in 1953, the manufacture of parts and assemblies of the Allison J35 turbojet engine for the U.S.A.F.

In addition to this work, the Company is responsible for the maintenance and repair of de Havilland Goblin engines for the Italian Air Force; overhaul and repair of components of the General Electric J47 turbojet engine (European Centre); and the manufacture of component parts of the J65 Sapphire turbojet engine, produced by the Curtiss-Wright Corporation, on behalf of the U.S.A.F. in Europe.

Fiat further undertakes, for the Italian Air Force and the Italian civil airlines, the overhaul and repair of several types of piston engines, including the Fiat RA. 1050 (D.B.605); Pratt & Whitney R-985, R-1830 and R-2800; and Rolls-Royce Merlin 500.

New factories have been built for this work, together with a test establishment of the most up-to-date design.

The first products of the Company's own research and design studies in the gas-turbine field are the Model 4002 turbojet engine for small and medium-sized civil and military aircraft, and the Model 4700 turbo-generator for helicopter use. Details of these units are given below.



The Fiat 4700 free-turbine air generator for helicopters.

THE FIAT 4700

The 4700 is a "free turbine" air generator which has been developed for helicopter use. The free air compressor is driven by a hot gas generator which makes use of components of the 4002 turbojet engine. The engine is arranged for vertical mounting so as to reduce the length of the compressed air duct to the rotor.

This engine will power the Fiat 7002 two-seat "cold jet" helicopter, in which the two-blade main rotor will be driven by jets of unheated compressed air at the blade tips.

TYPE.—Compressed-air turbo-generator.

AIR INTAKE.—Made in one piece with compressor casing, from a magnesium-zirconium alloy casting. Supports top main roller bearing, pumps and controls.

COMPRESSOR (Main).—Single-stage centrifugal type. 22 impeller blades milled from drop-forged light alloy. Diffuser casing comprises a magnesium-zirconium alloy casting on which an assembly of magnesium-zirconium alloy machined vanes is shrunk. Compression ratio 4 : 1. Air mass flow 4.7 kg./sec. (10.4 lb./sec.) at 25,000 r.p.m. at S/L.

COMBUSTION CHAMBER.—Annular type with 16 domes. Flame tube of nickel-chrome alloy sheet. Each dome fitted with single burner. Two B.T.H. C28TS/1 high-energy ignition units and two igniters.

PRIMARY TURBINE.—Single-stage axial-flow type. Casing fabricated from heat and corrosion resistant steel, with 25 hollow air-cooled nozzle guide vanes. Turbine wheel of steel alloy, with 49 inserted solid blades of nickel alloy, is flange-bolted to shaft.

FREE-POWER TURBINE.—Single-stage axial-flow type. Casing fabricated from heat and corrosion resistant steel, with 23 nickel alloy nozzle guide vanes. Turbine wheel of steel alloy, with 47 inserted solid blades of nickel alloy, attached to drive shaft of service compressor. Shaft supported in lower ball thrust bearing.

SERVICE COMPRESSOR.—Impeller of magnesium alloy with 22 milled vanes. Diffuser casing of magnesium-zirconium alloy. Compression ratio 3 : 1. Air mass flow 3.5 kg./sec. (7.7 lb./sec.) at 20,000 r.p.m. at S/L.

JET EXHAUST.—Fixed-area type with 90° deviation. Vaned and cooled duct.

CONTROL SYSTEM.—Hydro-mechanical type, with manual starting and acceleration controls. Single-lever master control.

FUEL SYSTEM.—Air-Equipement single fuel manifold with overspeed governor and relief valve. Air-Equipement control unit with altitude control. 16 Simplex burners.

FUEL GRADE.—D.Eng.R.D.2482 (JP-1).

LUBRICATION SYSTEM.—Recirculating type with pressure pump and 3 scavenge pumps. Air cooled oil cooler on intake casing. Pressure 3.5 kg./cm.² (50 lb./sq. in.).

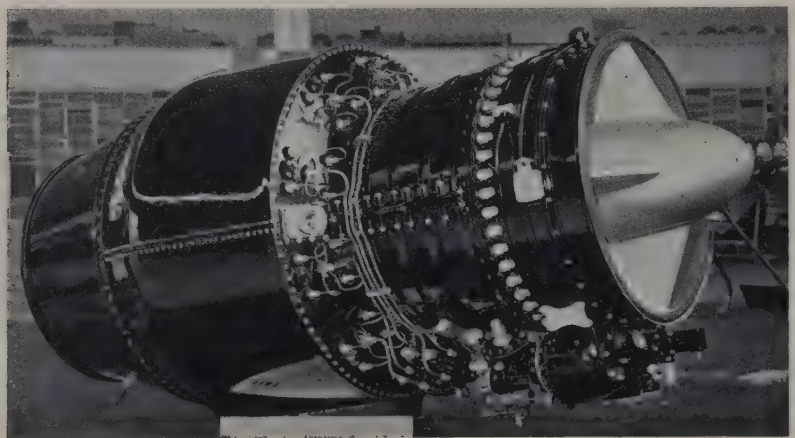
OIL SPECIFICATION.—D.Eng.R.D.2479, Aeroshell Turbine 9.

STARTER.—Pneumatic starter or Fiat electrical starter mounted on air intake.

DIMENSIONS.—
Diameter 600 mm. (23.6 in.).
Height 1,230 mm. (48.4 in.).

WEIGHT.—
Dry 120 kg. (265 lb.).

PERFORMANCE RATINGS.—
Take-off rating 542 gas h.p. at 25,000 r.p.m.
Normal rating 483 gas h.p. at 24,000 r.p.m.
Fuel at normal rating 0.57 kg./gas h.p./hr. (1.28 lb./gas h.p./hr.).
Oil at normal rating 0.35 kg./hr. (0.77 lb./hr.).



The Fiat 4032 turbojet engine (2,700 kg. = 5,950 lb. s.t.).

THE FIAT 4032.

The Fiat 4032 is the company's first axial-flow turbojet. It was displayed for the first time at the Technical Exhibition in Turin in 1957, and may power an advanced version of the Fiat G.91 fighter aircraft.

Choice of a reverse-flow layout has permitted overlapping of the combustion chamber on the rear portion of the compressor, with consequent reductions in weight and length of the engine. The rotating assembly is supported in only two bearings.

TYPE.—Axial-flow turbojet.

AIR INTAKE.—Annular casing of magnesium-zirconium alloy with four hollow struts supporting central bullet which houses starter and front main bearing. 48 fixed solid steel inlet guide vanes. Provision at bottom of casing for accessory gearbox.

COMPRESSOR.—Nine-stage axial-flow type. Two-piece aluminium alloy stator casing with eight rows of stator blades mounted directly on it. Rotor comprises nine aluminium alloy discs with aluminium alloy precision-forged blades. Discs clamped together and to shaft with through-bolts and supported in two-row ball thrust bearing at front. Compression ratio 5.5 : 1. Air mass flow 50 kg./sec. (110 lb./sec.) at 8,200 r.p.m. at S/L.

COMBUSTION CHAMBER.—Cannular reverse-flow type, comprising two-piece annular steel alloy outer shell containing ten interconnected flame tubes, each with four flame cups. 40 Simplex fuel burners around diffuser section ahead of chamber, with downstream injection. Two high-energy igniters.

TURBINE.—Single-stage axial-flow type. Casing consists of rear portion of combustion chamber outer shell and front portion of tail-pipe outer cone. 80 hollow air-cooled nozzle guide vanes of Nimonic 90 sheet. Rotor disc of ferritic steel, with 113 inserted solid blades of Nimonic 90. Disc bolted to shaft and supported in air-cooled roller bearing behind turbine wheel. Gas temperature 830°C. before turbine at 8,200 r.p.m.

JET PIPE.—Fixed area type. Outer and inner cones made from welded stainless steel sheet. Inner cone supported by 12 hollow struts.

CONTROL SYSTEM.—Hydro-mechanical type, with automatic starting and acceleration controls. Single-lever master control.

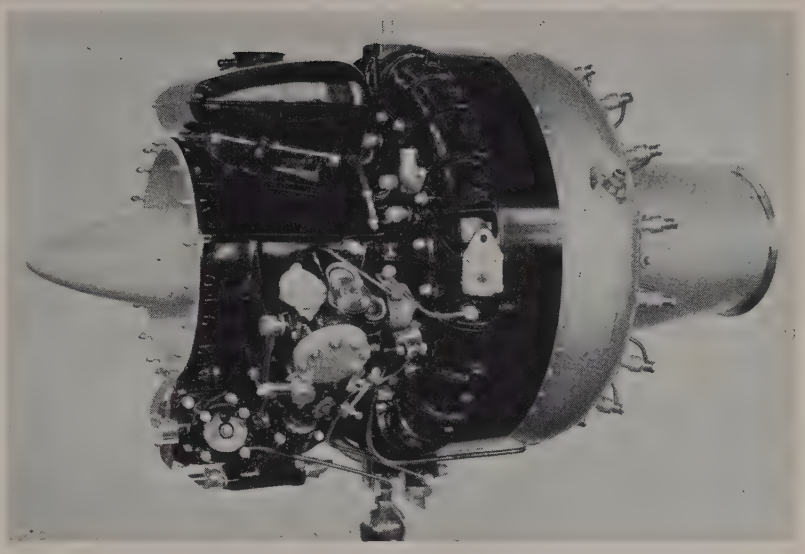
Fuel System.—Single fuel manifold. Two variable-stroke fuel pumps with overspeed governor. Barometric pressure control. Air-fuel ratio control. Throttle-valve and shut-off cock. Distributor supplies 40 Simplex burners.
Fuel Grade.—D.Eng.R.D.2482.
Lubrication System.—Dry sump type for front bearing, with gear-type pressure and scavenge pumps and two filters. Oil-spray for rear bearing, with metering pump, this oil being lost into exhaust duct.
Oil Specification.—D.Eng.R.D.2487.
Starter.—Optional electric, turbine or pneumatic type.
Dimensions.—
Diameter 1,070 mm. (42.12 in.).
Length 2,560 mm. (100.78 in.).
Frontal area 0.92 m.² (9.9 sq. ft.).
Weight.—
Dry 490 kg. (1,080 lb.).
Power Rating.—
Take-off rating 2,700 kg. (5,950 lb.) s.t. at 8,200 r.p.m.
Consumptions.—
Fuel at cruising rating 0.975 kg./kg. s.t./hr. (0.975 lb./lb. s.t./hr.).
Oil at cruising rating 0.70 kg./hr. (1.55 lb./hr.).

THE FIAT 4002.

The Fiat 4002 turbojet engine is intended for small and medium-sized civil and military aircraft. Special attention has been paid in its design to structural simplicity and consequent ease of production.

Its designers have concentrated on keeping length, rather than frontal area, to a minimum; because the minimum cross-sectional area of a single-engined aircraft is governed by factors such as cockpit size rather than by the frontal area of its engine.

Type.—Centrifugal-flow turbojet.
Air Intake.—Annular magnesium-zirconium alloy casting, with central bullet housing front bearing. Integral with compressor casing.
Compressor.—Single-stage centrifugal compressor in two parts. Impeller is of aluminium alloy and has 20 blades. Diffuser has 12 duralumin blades and 47 fabricated vanes. Compression ratio 4 : 1. Air mass flow 6.3 kg./sec. (13.9 lb./sec.) at 25,000 r.p.m.
Combustion Chamber.—Annular centripetal flow type made from stainless steel, with 16 flame tubes and 16 burners. Two high-energy igniters.
Fuel System.—Single manifold, volumetric flow pump, fuel flow regulator, 16 Simplex fuel nozzles.
Fuel.—D.Eng.RD.2482.
Turbine.—Single-stage axial-flow turbine. Rotor wheel made from steel alloy, with 47 nickel alloy blades. Front roller bearing. The 25 nozzle guide vanes are made from hollow precision castings and are air-cooled.
Jet Pipe.—Fixed-area type. Outer shell and inner cone fabricated from welded steel sheet.
Lubrication System.—Scavenge type, with one delivery pump and two scavenge pumps. Oil tank fitted to compressor air intake.
Oil Specification.—D.Eng.R.D.2479/D.
Starting.—Pneumatic or electrical starter.
Dimensions.—
Diameter 572 mm. (22.5 in.).
Length 885 mm. (34.8 in.).
Frontal area 0.257 m.² (2.8 sq. ft.).
Weight (Dry).—
85 kg. (187 lb.).
Rating.—
Max. static thrust 325 kg. (715 lb.) at 25,000 r.p.m.
Consumption.—
1.18 kg./kg. s.t./hr. (1.18 lb./lb. s.t./hr.).



The Fiat 4002 turbojet engine (325 kg.=715 lb. s.t.).

JAPAN

ISHIKAWAJIMA

ISHIKAWAJIMA JUKOGYO KABUSHIKI KAISHA (Ishikawajima Heavy Industries, Ltd.).

HEAD OFFICE AND WORKS: 54, TSUKUDAJIMA, CHUO-KU, TOKYO.

AERO-ENGINE FACTORY: 1010, TANASHI-MACHI, KITATAMA-GUN, TOKYO.

On June 19, 1956, the Japanese government approved a licence agreement under which Ishikawajima will produce spares for the General Electric J47-GE-27 turbojet engines which power Mitsubishi-built F-86F Sabre fighters.

This was the first step towards manufacture by Ishikawajima of complete J47 engines, and the licence covers also manufacture of spares for the J47's supplied to the Japanese Air Self Defense Force under M.D.A.P.

NIPPON

NIPPON JET-ENGINE COMPANY.

HEAD OFFICE: 1,010, TANASHI-MACHI KITATAMA-GUN, TOKYO.

A number of leading Japanese manufacturers have formed the Nippon Jet-Engine Company to co-ordinate their gas-turbine design and production activities under the auspices of the Japanese government.

The Nippon Jet-Engine Company has taken over from Fuji responsibility for the Model JO-1 turbojet and began bench tests of an improved version known as the J3-1 on July 3, 1956. It was awarded a contract in March, 1956, to produce three of these engines as part of the development programme for the Fuji T1F1 light jet training aircraft.

THE N.J.E. MODEL J3-1.

Three pre-production J3-1 engines have been ordered by the Japanese National Defense Agency. One will be fitted under the fuselage of a Curtiss-Wright C-46D transport aircraft for low-altitude flight testing. The other two will be mounted on the wing-tips of a Lockheed T-33A jet trainer for testing at heights above 3,000 m. (9,800 ft.).

In due course, the J3-1 will be evaluated in competition with the Bristol Orpheus as the potential power plant of the Fuji T1F jet trainer.

TYPE.—Axial-flow Turbojet.

AIR INLET.—Annular nose air inlet.

COMPRESSOR.—Eight-stage axial-flow. Rotor blades of precision-forged steel.

COMBUSTION CHAMBER.—Annular type. Kokusan Denki high-energy ignition with two N.G.K. igniter plugs.

FUEL SYSTEM.—Dual fuel-manifold system. N.J.E. fuel pump, governor, relief valve, flow control unit and filter. Mechanical control system, with automatic barometric and speed controls and single-lever master control.

FUEL GRADE.—JP-4.

NOZZLE GUIDE VANES.—Single row.

TURBINE.—Single-stage axial-flow type. Precision-forged blades.

JET PIPE.—Fixed type.

LUBRICATION SYSTEM.—Forced-feed system for main bearings and gear case. Dry sump. Gear-type pressure pumps.

STARTING.—Shinko Denki starter. Optional starting by air jets impingeing on compressor blades.

DIMENSIONS.—
Diameter (basic) 600 mm. (23.6 in.).
Diameter overall 720 mm. (28.35 in.).
Length 1,850 mm. (72.85 in.).
Frontal area 0.28 m.² (3.01 sq. ft.).

DRY WEIGHT.—
370 kg. (815 lb.).

PERFORMANCE RATING.—
Max. static thrust at S/L 1,200 kg. (2,645 lb.).

CONSUMPTION.—
At normal rating 1.08 kg./kg. s.t./hr. (1.08 lb./lb. s.t./hr.).

THE N.J.E. MODEL JO-1.

TYPE.—Axial-flow Turbojet.

AIR INLET.—Annular nose air inlet surrounding nose bullet.

COMPRESSOR.—Eight-stage axial-flow. First and eighth blade discs of stainless steel, the remainder are aluminium-alloy forgings. Air mass flow approximately 19 kg. (41.8 lb.) sec. Compression ratio about 4.5 : 1.

COMBUSTION CHAMBERS.—Eight straight-through chambers of stainless steel each with a concentrically-mounted perforated stainless steel flame tube with duplex-type fuel injection nozzle in the front end and discharging downstream. Chambers are interconnected to permit flame-spread during starting.

FUEL SYSTEM.—Single fuel-manifold system. Fuel pressure at maximum power 50 kg./cm.² (710 lb./sq. in.).

NOZZLE GUIDE VANES.—Forged steel ring with forty inserted and welded Nimonic 80A nozzle guide vanes.

TURBINE.—Single-stage axial flow, with sixty solid blades inserted in periphery of alloy-steel disc. Gas temperatures (at 12,000 r.p.m.) before turbine 800°C., after turbine 630°C.

JET PIPE.—Outer casing of stainless steel. Fixed inner cone.

LUBRICATION.—Wet sump. Main gear-type pump supplies oil to five main bearings. Auxiliary pump scavenges sump under turbine roller bearings and returns it to main pumps.

STARTING.—Direct-drive electric. Two torch igniters.

DIMENSIONS.—
Length 2,850 mm. (112 in.).
Diameter 680 mm. (26.7 in).
Frontal area 0.33 m.² (3.56 sq. ft.).

WEIGHT DRY.—
450 kg. (990 lb.).

PERFORMANCE RATINGS.—
Max. static thrust 1,000 kg. (2,200 lb.) at 12,000 r.p.m.
Max. thrust at 800 km.h. (500 m.p.h.) at 9.000 m. (29,520 ft.) 400 kg. (880 lb.).

FUEL CONSUMPTION.—
1.11 kg./kg. s.t./hr. (1.11 lb./lb. s.t./hr.).

POLAND

In common with the Polish airframe industry, the country's aero-engine factories were engaged mainly on producing equipment of Russian design until recently when development of nationally-designed engines has again been encouraged.

Klimov VK-1 turbojets have been in production since at least 1955 to power the Polish-built MiG-15 and MiG-17 fighters. The only nationally-designed jet engines of which details are yet available are the Wojcicki pulsejets described briefly hereafter.

S. WOJCICKI.

S. Wojcicki has designed a pulsejet engine, similar to the French SNECMA Escopette and giving 10 kg. (22 lb.) s.t. Four of these units have been fitted in pairs under the wings of a modified Bocian glider for flight testing. Wojcicki is also developing a more powerful pulsejet of 20 kg. (44 lb.) s.t.

Two Wojcicki pulsejets were built at the Aircraft Institute (Aero-engine Department) in 1955. Apart from the fact that they develop 40 kg. (88 lb.) s.t. and 70 kg. (154 lb.) s.t. respectively, nothing is known about them.

Ramjet unit have also been developed in recent years and two Wojcicki 11 kg. (24 lb.) ramjets are fitted to the JK-1 Trzmiel helicopter. A 200 kg. (440 lb.) s.t. ramjet, completed at the I.L., is shown in the accompanying photograph. No details of these engines are available.



The 200 kg. (440 lb.) s.t. Wojcicki Ramjet.

SOVIET UNION

(Union of Socialist Soviet Republics)

THE RD-45 AND RD-45F.

The Russian production version of the Nene, converted to Russian standards by a team of engineers under Chelomey and Klimov after 25 Rolls-Royce-manufactured Nenes and 30 Derwents had been exported to the Soviet Union in 1947, was designated the RD-45. A subsequent improved version was the RD-45F and these engines were built in quantity for initial production versions of the MiG-15 and Il-28. The RD-45F has a rating of approximately 2,470 kg. (5,450 lb.) s.t.

THE RD-500.

RD-500 is the designation of the Derwent 5 built in the U.S.S.R. It retains the main features of its British prototype, and is installed in the Yak-23 jet fighter.

THE VK-1.

Under the leadership of V. Y. Klimov, the Russians developed the Nene in much the same way as that by which the Tay was developed from the Nene by both Rolls-Royce and Pratt & Whitney. Without increasing the overall diameter the engine was re-designed internally, to permit about 30 per cent. more air to pass through the engine, and to enable it to develop a static thrust of 2,700 kg. (5,955 lb.) for an engine weight of 900 kg. (2,000 lb.) as compared with 2,270 kg. (5,000 lb.) s.t. and 780 kg. (1,715 lb.) weight of the original Nene.

Known as the VK-1, the redesigned engine powers the MiG-15*bis* and most production Il-28's. More than 20,000 were built in 1950-56 in Engine Plant No. 45, near Moscow.

The VK-1A which powers the MiG-17 is fitted with an afterburner and has a rated putput of 3,450 kg. (7,590 lb.) s.t.

THE VK-5.

The VK-5 is reputedly the power-plant of the MiG-19 and Yak-25. Little is known about this power-unit beyond the fact that it has a rated output of 3,950 kg. (8,690 lb.) s.t. at sea level.

THE LU-4 (?).

The LU-4(?) axial-flow gas turbine is a recent Russian design which is credited to A. M. Lyulka. It is said to have a static thrust rating of 5,200 kg. (11,455 lb.), and four engines of this type are believed to power the Tu-110 airliner. No reliable data are available.

THE M-209 (RD-3).

The Mikulin M-209 is a large but very simple single-spool axial-flow turbojet which powers the Tu-16 bomber and, in a de-rated civil form known as the RD-3, the Tu-104 airliner. It has an eight-stage compressor, "cannular" type combustion system and a two-stage turbine. The civil version has an electric starter and manifolds for cabin pressurisation and hot-air de-icing. Mass flow is estimated at 125 kg. (278 lb.) sec., with a compression ratio of 6.8 : 1. The following data are estimated :—

DIMENSIONS.—
Length 5,080 mm. (200 in.).
Diameter 1,370 mm. (54 in.).
DRY WEIGHT.—
2,495 kg. (5,500 lb.).
PERFORMANCE RATINGS.—
Max. rating (military) 8,200 kg. (18,040 lb.) s.t.
Max. rating (civil) 6,750 kg. (14,850 lb.).

THE RD-3M.

A developed version of the M-209 has been produced under the design leadership of P. F. Zubets. It gives 8,700 kg. (19,180 lb.) s.t. and two engines of this type power the Tu-104A airliner.

THE TYPE 022.

The Type 022 was the first of a series of turboprop engines produced at Kubishev by a strong team of German and Russian engineers. It is based on a wartime German Junkers design and has a simple single-spool axial-flow compressor.

First bench-run in 1950, the Type 022 powers the An-8 transport aircraft.

DIMENSIONS.—
Length 4,500 mm. (177.2 in.).
Diameter 1,050 mm. (41.3 in.).
DRY WEIGHT.—
With accessories 1,400 kg. (3,087 lb.).
PERFORMANCE RATING.—
Max. rating at S/L 5,700 s.h.p. plus approx. 600 kg. (1,323 lb.) jet thrust at 7,650 r.p.m.
CONSUMPTION.—
Fuel at max. rating 0.245 kg. (0.54 lb.) h.p./hr.

THE NK-4.

The NK-4 is a turboprop engine of approximately 4,000 s.h.p. developed by N. D. Kuznetsov. Few details are available, but four NK-4 engines power the Il-18 airliner and have been stated to have a remarkably low specific fuel consumption.

THE IVCHENKO TURBOPROP.

A. G. Ivchenko has developed an improved version of the NK-4 turboprop. No details are available, but four of these engines power the prototype of the An-10 Ukraina and will eventually replace the NK-4 turboprops fitted at present to the Il-18.

THE NK-012M.

Designed at Kubishev under the leadership of N. D. Kuznetsov and German engineers, the Type NK-012M is the large turboprop engine of which four power the Tupolev "Bear" bomber. It develops some 12,000 s.h.p. and drives large contra-rotating airscrews.

The Type K has a single 14-stage axial-flow compressor, and the complete rotating assembly weighs about a ton. Compression ratio varies from 9 : 1 to 13 : 1 according to altitude, and variable inlet guide vanes and blow-off valves are provided to facilitate engine handling. A cannular-type combustion system is used, each separate flame tube being mounted centrally on a downstream injector. But all tubes merge at their maximum diameter to form an annular secondary region. The turbine is of the five-stage axial-flow type. Mass flow is 62 kg. (137 lb.) sec.

The casing is made in four portions, from sheet steel, and is precision-welded together.

DIMENSIONS.—
Length 6,000 mm. (236.2 in.).
Diameter 1,150 mm. (45.3 in.).
DRY WEIGHT.—
2,300 kg. (5,070 lb.).
PERFORMANCE RATING.—
Max. rating at S/L 12,000 s.h.p. plus 1,200 kg. (2,645 lb.) jet thrust at 9,250 r.p.m.
Max. rating at 11,000 m. (36,000 ft.) 8,000 s.h.p. at 9,250 r.p.m.
FUEL CONSUMPTIONS.—
At max. rating at S/L 0.26 kg. (0.573 lb.) h.p./hr.
At max. rating at 11,000 m. (36,000 ft.) 0.16 kg. (1,353 lb.) h.p./hr.

SWEDEN

FLYGMOTOR

SVENSKA FLYGMOTOR AB.

HEAD OFFICE AND WORKS: TROLLHÄTTAN.

Svenska Flygmotor AB. holds licences to build the de Havilland Ghost and Rolls-Royce Avon RA.7R engines.

The Flygmotor RM2B, which is in production for the Saab-29F, is manufactured under a D.H. Ghost 50 licence and is fitted with an afterburner designed by the Royal Swedish Air Board in collaboration with Flygmotor.

The Flygmotor RM5 is the licence-built Avon RA.7R which powers the Saab-32A two-seat all-weather fighter, now in production for the Royal Swedish Air Force.

Flygmotor are also building the later 200-Series Avon, under the designation of RM6. Engines of this type power the Saab-32B Lansen and Saab-35 Draken.

THE FLYGMOTOR RM2B GHOST.

The basic engine is built under licence from the de Havilland Engine Co., Ltd. The afterburner, of the short type, is of Swedish design. Structural details of the Ghost will be found under "de Havilland."

DIMENSIONS.—
Diameter 1,346 mm. (53 in.).
Length 3,630 mm. (143 in.).
WEIGHT DRY (with afterburner).—
1,110 kg. (2,450 lb.).
RATINGS.—
Max. static with afterburning 2,800 kg. (6,200 lb.) s.t. at 10,250 r.p.m.
Max. static without afterburning 2,160 kg. (4,750 lb.) s.t. at 10,250 r.p.m.
FUEL CONSUMPTION.—
With afterburning 2.2 kg./kg. s.t./hr. (2.2 lb./lb. s.t./hr.).
OIL CONSUMPTION.—
Normal 0.7 kg./hr. (1.6 lb./hr.).

THE FLYGMOTOR RM2 GHOST.

The RM2 is similar to the RM2B but it is not fitted with an afterburner.

WEIGHT DRY.—
990 kg. (2,185 lb.).
RATING.—
Max. static thrust 2,270 kg. (5,000 lb.) s.t. at 10,250 r.p.m.

THE FLYGMOTOR RM5 AVON.

The RM5 is the Rolls-Royce Avon RA.7R axial-flow turbojet engine built under licence. Full details of the Avon RA.7R will be found under "Rolls-Royce."

THE FLYGMOTOR RM6 AVON.

The RM6 is the designation of the licence-built Rolls-Royce 200 Series engine which is installed in the Saab-32B Lansen all-weather fighter and the Saab-35A Draken supersonic all-weather "double-delta" fighter. In both installations the RM6 is fitted with a Swedish-developed afterburner. Details of the Avon 200 Series engine will be found under "Rolls-Royce".

UNITED STATES OF AMERICA

AEROJET

AEROJET-GENERAL CORPORATION (Subsidiary of The General Tire & Rubber Company).

Head Office and Works: Azusa, California.

Solid Rocket and Liquid Rocket Production Works: Sacramento, Cal.

Nucleonics Division: San Ramon, Cal.

Ordnance Engineering Division: Frederick, Maryland.

President: Dan. A. Kimball.

Executive Vice-President: A. H. Rude.

Vice-President and General Manager: W. E. Zisch.

Vice-President, Engineering: C. C. Ross.

Vice-President, Manufacturing: K. F. Mundt.

Vice-President, Liquid Rocket Plant: R. B. Young.

Secretary: T. E. Beehan.

Treasurer: R. L. McKenzie.

The Aerojet-General Corporation is the largest industrial organisation in the United States devoted to research, development and manufacture of rocket engines and associated equipment for military and commercial use. Its products include large and small liquid and solid propellent rocket engines for the assisted take-off and in-flight thrust augmentation of piloted aircraft; rocket boosters and primary power plants for missiles; upper atmosphere research rockets; thrust reversers for turbojet engines; auxiliary power units and gas generators; underwater propulsion devices; and ordnance warheads.

Aerojet's type 5KS-4500 solid propellent JATO (jet assisted take-off) units assist the take-off of heavily-loaded carrier-borne aircraft, and type 15KS-1000 units are used as standby power plants on many other military aircraft.

Missile applications of the company's solid-propellent rockets include the boosters on the Chance Vought Regulus, the sustainer motors of the Douglas/Sperry Sparrow and the sustainer motor of the Lockheed Polaris. An Aerojet liquid-propellent sustainer rocket powers the Douglas Nike Ajax anti-aircraft missile.

Aerojet Aerobee upper atmosphere research rockets have been used widely for many years and one of the latest Aerobee-Hi versions attained an altitude of 193 miles (310 km.) over White Sands, New Mexico, in the Spring of 1957. Many more are scheduled to be fired to heights of 180-200 miles (290-320 km.), from an arctic launching facility built by Aerojet engineers at Fort Churchill on Hudson Bay, Canada, during the International Geophysical Year, 1957-58.

It is reported that Aerojet are testing motors developing up to 1,000,000 lb. (453,600 kg.) s.t. from three or four chambers. The company was also responsible for the second-stage motor for the Project Vanguard earth satellite vehicle.

The Systems Division of Aerojet-General has designed a rocket, known as the Aerobee Moon Rocket, which the company believes could put a satellite in orbit around the moon in a relatively short time.



Aerojet missile boosters and Jato rockets. From top to bottom: Models 2.2KS-33000, 5KS-4500, 2.2KS-11000, 15KS-1000, 14AS-1000 and (top right) 12AS-250 Junior Jato. Some are no longer in production.

In April, 1957, Aerojet and D. Napier and Son, Ltd. of England signed an agreement for the exchange of technical information on liquid-propellent rocket engines, in particular those using high test peroxide. Later it was announced that Aerojet had acquired the licence to manufacture in America the Napier Scorpion rocket engine.

THE AEROJET MODEL 2.5KS 18000 ROCKET.

No details are available of this solid-propellent rocket motor, except that it is used as a booster for the Aerobee Model 100 and Model 150 research sounding rockets. Its designation indicates a thrust of 18,000 lb. (8,165 kg.).

THE AEROJET MODEL 15KS-1000 Mk. 6, Mod. 1 ROCKET.

The 15KS-1000 (1,000 lb.=455 kg. of thrust for 15 seconds) "smokeless" JATO rocket is in full production, and has been delivered to the U.S.A.F. and U.S. Navy.

Prior to the development of the 15KS-1000 unit, the use of JATO was accompanied by a large stream of smoke which trailed behind the aircraft when the unit was fired. In cases where the smoke did not dissipate, due to lack of wind, operations were often affected by the smoke screen created by the first few take-offs. The new smokeless unit, which can operate over a much wider temperature range, gives an extra second of 1,000 lb. thrust with a 25% reduction in weight. The 15KS-1000 unit, which weighs 143 lb. (65 kg.) can be installed on the old type fittings without modification.

This rocket motor has been awarded United States Civil Aeronautics Administration approved Engine Type Certificate No. 249 for airline use.

THE AEROJET MODEL 15NS-250 ROCKET.

At the end of 1957, it was announced that C.A.A. certification was virtually completed on a new Junior JATO rocket designated 15NS-250. It is an ammonium-nitrate solid-propellent unit which provides 250 lb. (113 kg.) s.t. for 15 seconds and is intended for use on aircraft with a gross weight of 10,000 lb. (4,535 kg.) or less.

THE AEROJET MODEL 5KS-4500 Mk. 7, Mod. 1 ROCKET.

Type.—Single-chamber type JATO rocket motor.

Propellent.—Solid type. Comprises solid fuel and oxydiser moulded into cartridge secured in cylindrical steel chamber.

Ignition.—By electrically-energised glow-plug situated inside end of nozzle.

Dimensions.—
Diameter 9.38 in. (23.8 cm.).
Overall length 54.6 in. (138.6 cm.).

Weight.—
236 lb. (107 kg.).

Performance.—
Rated thrust 4,500 lb. (2,045 kg.).
Rated duration 5 sec.
Total impulse 22,500 lb. (10,215 kg.) per sec.

THE AEROJET MODEL AJ10-24 BOOSTER ROCKET ENGINE.

Type.—Liquid bi-propellent rocket, gas or chemically-pressurised. Used to propel the Aerobee research rocket.

Construction.—Assembly consists of a cylindrical section which contains the oxidiser, fuel and pressurising tanks. The pressure regulator and rocket motor are attached to the tank section of the Aerobee.

Dimensions.—
Diameter 15 in. (38.10 cm.).
Length 130 in. (330.2 cm.).

ALLISON

THE ALLISON DIVISION, GENERAL MOTORS CORPORATION.

Head Office and Works: Indianapolis 6, Ind.

General Manager: E. B. Newill.

Assistant General Manager: Harold H. Dice.

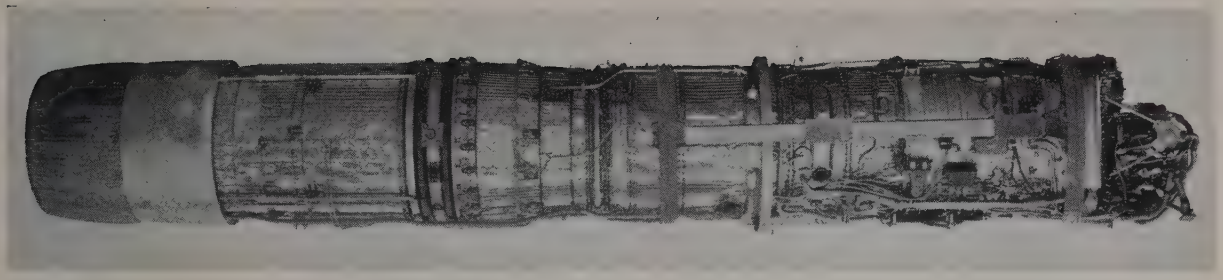
Director of Engineering: Dimitrius Gerdan.

Manufacturing Manager for Aircraft Engines Operations: Harold R. Laubach.

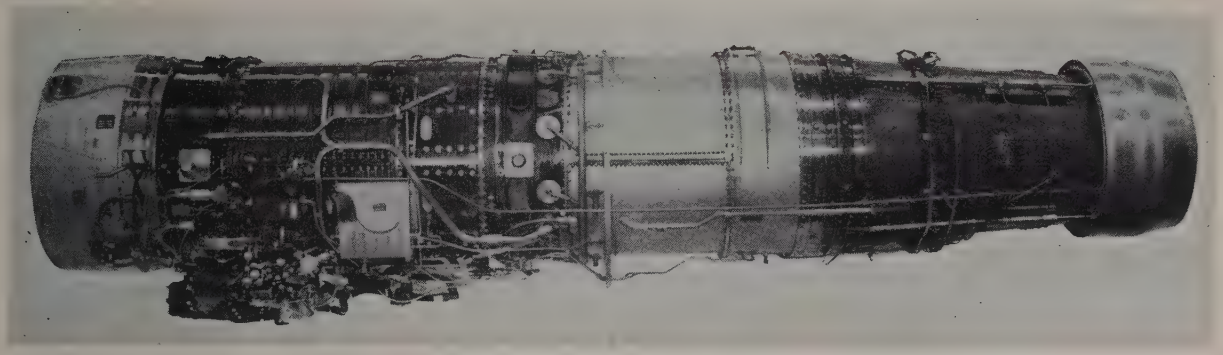
The Allison Division of the General Motors Corporation delivered its 100,000th aero-engine early in 1956. About 70% of these were V-1710 piston-engines. The remainder were mostly J33 and J35 turbojets of General Electric design, and by the beginning of 1956 more than seven million flying hours had been accumulated by Allison turbine engines.

An important part of the company's work has been the development of the short-life J33-A-37 centrifugal-flow turbojet for missile applications, and this engine continues in production, together with the J71 axial-flow turbojet.

Also in production is the T56 turboprop, which powers the Lockheed C-130A transport. A variant of the T56, designated Allison Model 501, is in production for the Lockheed Electra transport.



The Allison J71-A-2 turbojet engine with afterburner (14,000 lb.=6,350 kg. s.t. maximum).



The Allison J71-A-11 axial-flow turbojet engine (10,200 lb.=4,625 kg. s.t. maximum).

THE ALLISON J71 SERIES.

The J71 is a completely new engine embodying a number of notable changes in design.

A new combustion system incorporates what Allison calls a "cannular" burner section, in which ten individual combustion chambers are enclosed in a large outer annular type chamber. After compression and ignition in the outer chamber the mixture is bled into the inner "cans" where, in effect, the mixture is re-heated.

The J71 has sixteen stages of compression and a three-stage turbine, and it is fully equipped for all-weather operation. Hot air can be bled from the compressor to the air-inlet vanes and central "bullet" and automatically retractable air inlet screens are provided. An automatic ice-detector is also supplied. The air inlet screens and the variable-area jet nozzle are hydraulically operated by the engine's own independent hydraulic system. It also has its own integral oil system.

Incorporation of a Minneapolis-Honeywell electro-hydraulic control system makes the J71 largely self-protecting and automatic in operation.

The J71 has passed the official U.S.A.F. qualification test with a demonstrated thrust exceeding 10,000 lb. (4,540 kg.) at 6,100 r.p.m., with a fuel consumption of 0.8 lb./hr./lb. s.t. (0.8 kg./hr./kg. s.t.).

The following versions of the J71 have so far been announced :—

J71-A-2. Powers McDonnell F3H-2N Demon. Fitted with afterburner to give maximum thrust of 14,000 lb. (6,350 kg.).

J71-A-6. Version with short afterburner for prototypes of Martin XP6M-1 SeaMaster flying-boat. Maximum thrust 13,000 lb. (5,900 kg.).

J71-A-11. Powers the Douglas RB-66B.

All further details are classified except for the following :—

DIMENSIONS (J71-A-2).—
Diameter 42 in. (1,067 mm.).
Length, with extension pipe 284.6 in. (7,230 mm.).

WEIGHT (J71-A-2).—
With accessories 4,869 lb. (2,208 kg.).

THE ALLISON MODEL 550.
Military designation: T61.

Dimensionally similar to the Model 501, the Allison Model 550 will be a two-spool turboprop of advanced design for service after 1960. Compression ratio will be about 13 : 1 and the rated power not less than 5,000 e.h.p., with a fuel consumption of about 0.385 lb./h.p./hr. (0.176 kg./h.p./hr.).

THE ALLISON T56.

The T56 turboprop was evolved from Allison's original T38 engine and was first flown in the nose of a B-17 test bed in 1954. Later two Convair YC-131C transports were each fitted with two YT56 engines, rated at 3,250 h.p., and these aircraft completed 3,000 hours of development flying with the 1,700th M.A.T.S. Squadron between May and December, 1955.

The following three production versions have been announced:—

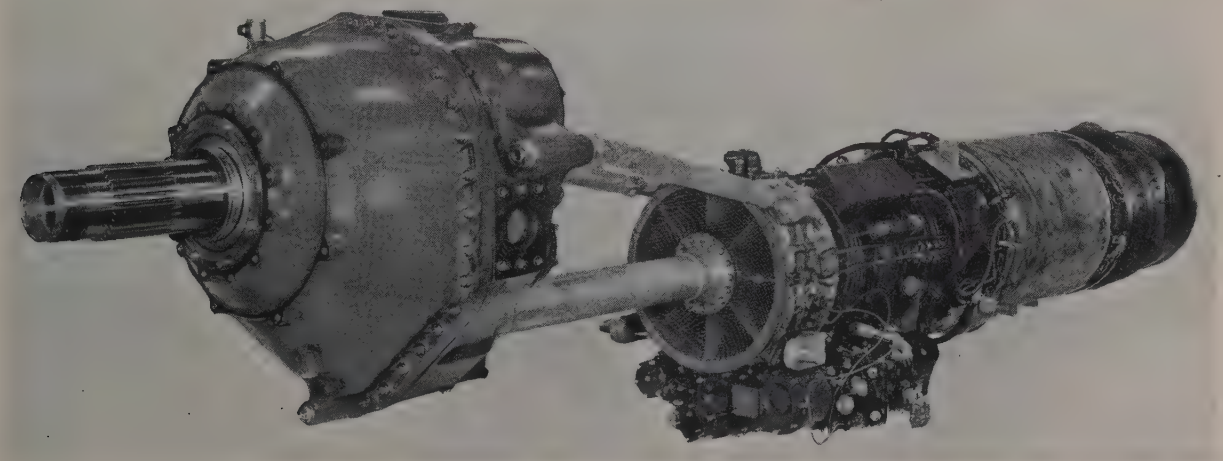
T56-A-1. Powers the Lockheed C-130A transport aircraft.

T56-A-2. Ordered by the U.S. Navy for possible helicopter application.

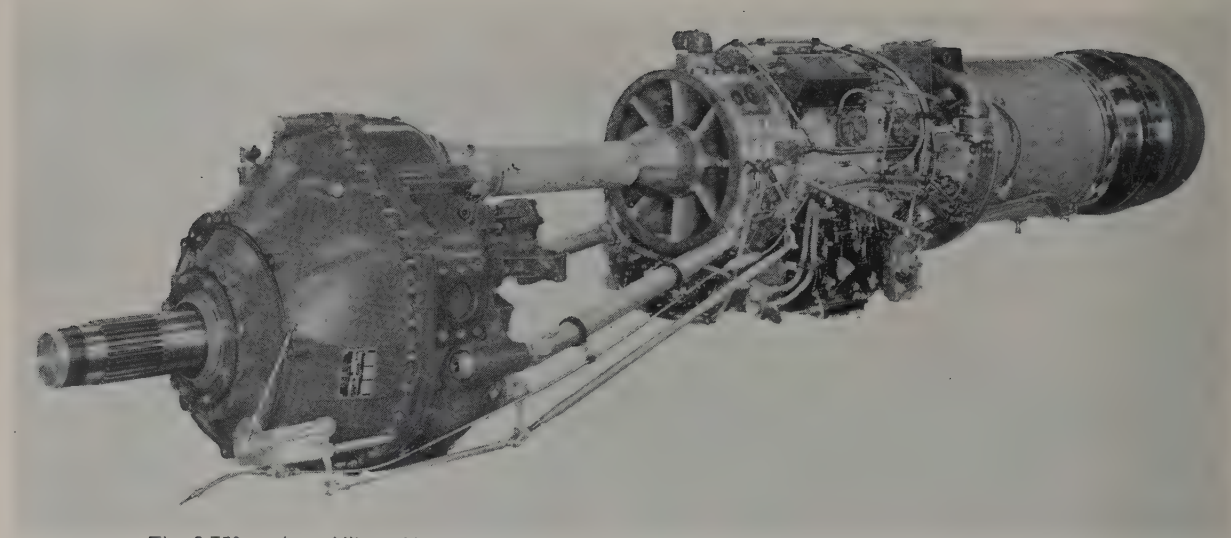
T56-A-7. Military version of Model 501-D15. For installation in Lockheed C-130B.

TYPE.—Turboprop with 14-stage axial-flow compressor and 4-stage turbine.

AIRSCREW DRIVE.—Combination spur/planetary gear type, primary step-down by spur (3.125 : 1), secondary by planetary (4.0 : 1). Overall gear ratio 12.5 : 1. Power section r.p.m. 13,820, airscrew shaft r.p.m. 1,106. Cast magnesium reduction-gear housing. Gearbox assembly supported from power section by main drive shaft casing 28 in. (71 mm.) long and two inclined struts. Weight of gearbox assembly approximately 450 lb. (204.3 kg.) with pads on rear face for accessory mounting.



The 3,750 e.s.h.p. Allison T56-A-1 turboprop engine.



The 3,750 e.s.h.p. Allison Model 501-D13 turboprop engine, which powers the Lockheed Electra.

AIR INTAKE.—Circular duct on engine face. Thermal de-icing. Inlet air flow 32.5 lb./sec. (14.75 kg./sec.).

COMPRESSOR.—Fourteen-stage axial-flow. Series of fourteen discs with rotor blades dovetailed in peripheries and locked by adjacent discs. Rotor assembly tie-bolted to shaft which runs on one ball and one roller type bearings. Fifteen rows of stator blades, welded in rings. Disc, rotor and stator blades and two-piece welded casing of stainless steel. Compressor inlet area 155.65 sq. in. (1,004 cm.²). Compression ratio 9.25 : 1. Mass air flow 32.5 lb./sec. (14.75 kg./sec.).

COMBUSTION CHAMBERS.—Six stainless steel cannular-type perforated combustion liners within one-piece stainless steel outer casing. Fuel nozzles in forward end of each combustor liner. Primary ignition by two igniters in diametrically-opposite combustors.

FUEL SYSTEM.—High-pressure type. Bendix control system.

FUEL GRADE.—Mil-F-5624B Grade JP-4, or Gasoline Grade 100/130.

NOZZLE GUIDE VANES.—Seventy-eight solid cast GMR-235 steel alloy guide vanes.

TURBINE.—Four-stage. Rotor assembly consists of four stainless steel discs, first three with cast GRM-235 blades and the fourth with forged S-816 blades, all secured in peripheries of discs by "fir-tree" roots. Discs splined to rotor shaft which runs on front and rear roller bearings. Steel outer turbine casing. Gas temperature before turbine 1,780°F.

JET PIPE.—Fixed. Stainless steel.

ACCESSORY DRIVES.—Accessory pads on rear face of reduction-gear housing at front end of engine.

LUBRICATION SYSTEM.—High pressure. Dry sump. Pesco dual-element oil pump. Normal oil supply pressure 180-200 lb./sq. in. (12.6-14 kg./cm.²).

OIL SPECIFICATION.—Mil-L-7808.

MOUNTING.—Three-point suspension.

STARTING.—Air turbine, gear-box mounted.

DIMENSIONS.—
Width 27.5 in. (698.5 mm.).
Height 40 in. (1,016 mm.).
Length 145.1 in. (3,685.5 mm.).

WEIGHT.—
With accessories 1,645 lb. (746.8 kg.).

PERFORMANCE RATINGS (T56-A-1).—
Take-off 3,750 equivalent s.h.p.
Normal 3,375 equivalent s.h.p.

CONSUMPTION.—
Fuel 0.540 lb./h.p./hour (0.245 kg./h.p./hour) at 3,750 e.s.h.p. S/L. static.

THE ALLISON MODEL 501.

The Model 501 is the commercial version of the T56 turboprop, and has been chosen to power the Lockheed Electra transport. 75% of the components in the two engines are interchangeable. Changes compared with the T56 are the introduction of a new compressor casing consisting of four forged quadrants bolted permanently together, repositioning of the reduction gear to below the power section and provision for operating on kerosene fuel.

On May 20, 1955, the Model 501 was awarded Type Certificate No. 282 by the C.A.A. and so became the first U.S. turboprop approved for commercial operation. Two versions have been announced :—

Model 501-D13. Initial version for the Electra, for service in 1958. Reduction gear ratio 13.54 : 1, primary step-down by spur (3.13 : 1), secondary by planetary (4.33 : 1). Rated at 3,460 s.h.p. plus 726 lb. (329 kg.) jet thrust (3,750 e.h.p.) for take-off.

Model 501-D15. Developed version for service in 1959. Inlet guide vanes removed to increase air mass flow. First two rows of turbine blades shrouded. Rated at 4,050 e.h.p.

DIMENSIONS (Model 501-D13).—
Width 27 in. (686 mm.).
Height 36 in. (914 mm.).
Length 145.2 in. (3,688 mm.).

WEIGHT (Model 501-D13).—
Dry, with accessories 1,750 lb. (794 kg.).

PERFORMANCE (Model 501-D13).—
Take-off 3,460 s.h.p. plus 726 lb. (329 kg.) jet thrust at 13,820 r.p.m.
Max. continuous 3,094 s.h.p. plus 702 lb. (318 kg.) jet thrust at 13,820 r.p.m.
Max. cruising 1,850 s.h.p. plus 145 lb. (66 kg.) jet thrust at 13,820 r.p.m. at 406 m.p.h. (653 km.h.) at 25,000 ft. (7,620 m.).

FUEL CONSUMPTIONS (Model 501-D13).—
Take-off rating 0.54 lb./h.p./hr. (0.245 kg./h.p./hr.).
Max. continuous rating 0.552 lb./h.p./hr. (0.25 kg./h.p./hr.).
Max. cruising rating 0.458 lb./h.p./hr. (0.208 kg./h.p./hr.).

THE ALLISON J33 SERIES.

The current models in the J33 Series are :—

J33-A-18A. Powers the Chance Vought Regulus I surface-to-surface missile.

J33-A-41. Powers the Martin TM-61 and TM-76 tactical missiles. Short-life engine with reduced number of components in accessories section. It has no air inlet screens and an elongated one-piece exhaust cone-tailpipe. 85% reduction in use of critical materials which, with elimination of components not needed in an expendable engine, results in 30% reduction in cost.

A full structural description of the J33 Series engine has appeared in previous editions of "All the World's Aircraft".

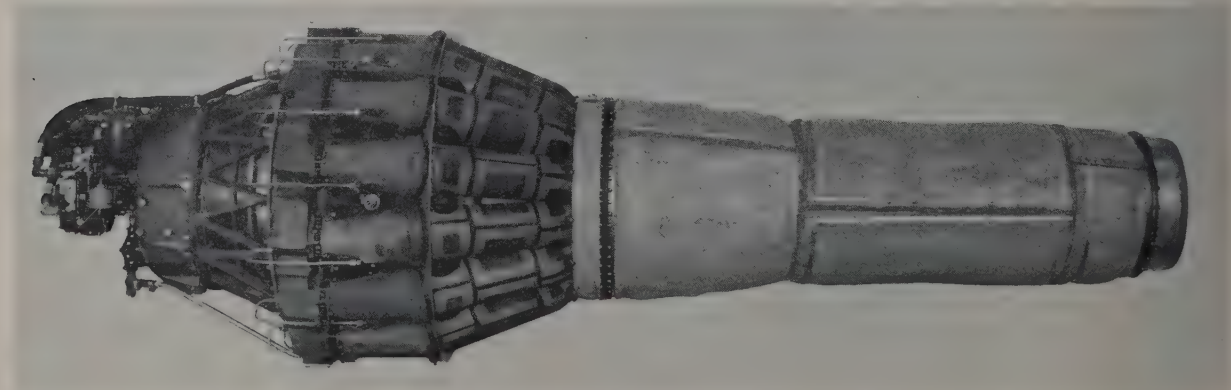
DIMENSIONS (J33-A-41).—
Diameter 49⅝ in. (1,252 mm.).
Overall length 159.5 in. (4,051 mm.).

WEIGHTS (Dry).—
J33-A-41 1,790 lb. (812.6 kg.).

PERFORMANCE RATINGS (J33-A-18A).—
Military 4,600 lb. (2,088 kg.).
Normal 3,900 lb. (1,770 kg.).

PERFORMANCE RATING (J33-A-41).—
Continuous max. 4,600 lb. (2,088 kg.).

CONSUMPTIONS (J33-A-18A and 41).—
Fuel 1.14 lb./hr./lb. s.t. (1.14 kg./hr./kg. s.t.) military, 1.12 lb./hr./lb. s.t. (1.12 kg./hr./kg. s.t.) normal.
Oil 2.2 lb. (1.0 kg.) per hour military, 1.18 lb. (0.53 kg.) per hour normal.



The Allison J33-A-41 "short life" turbojet engine which powers the Martin TM-61 and TM-76 tactical missiles.

ASTRODYNE

ASTRODYNE, INC.

HEAD OFFICE AND WORKS: MCGREGOR, TEXAS.

Astrodyne, Inc., was formed in 1958 by North American Aviation and Phillips Petroleum Company to design, develop and manufacture complete propulsion systems, extruded and cast propellents, rocket engines, missile controls and components, boosters, gas generator charges and auxiliary power units.

The company is continuing the advanced research and manufacture of solid-propellent rockets on which the former Rocket Fuels Division of Phillips Petroleum was engaged for five years prior to formation of the joint concern. Current production is concerned mainly with 1,000 lb. (450 kg.) s.t. JATO units and the 130,000 lb. (58,970 kg.) s.t. XM-34 booster rocket used for zero-length launching of the North American F-100D fighter. Over 130,000 of the JATO units have been produced.

BOEING

BOEING AIRPLANE COMPANY, INDUSTRIAL PRODUCTS DIVISION.

HEAD OFFICE AND WORKS: SEATTLE 24, WASH.

Officers: See under "Boeing" on page 264.

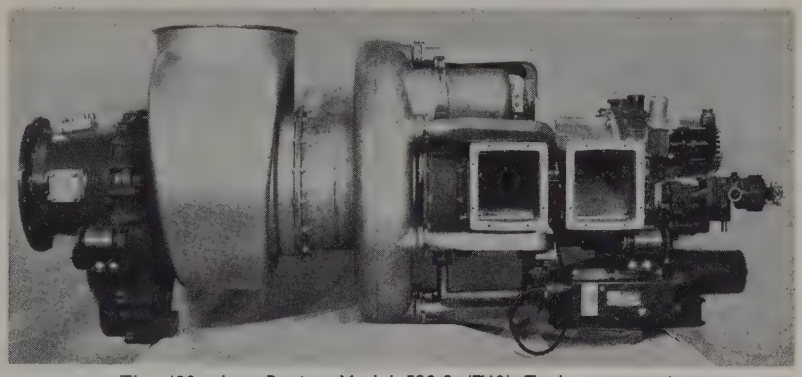
In 1943, when the U.S. Army Air Forces became interested in the possibilities of using gas-turbines in large aircraft, the Boeing company decided to initiate its own propulsion research programme and a jet-propulsion laboratory was set up in the main plant at Seattle as a pure research project with the object of evaluating all data on gas-turbines. Later, the decision was made to build various turbine components and to evaluate them separately.

Axial-flow and centrifugal compressors and other components were built. Design studies progressed to the point where the original research project was expanded to embrace the complete assembly of experimental power-units, culminating in the design of many other small gas-turbines which are now being built in experimental and production quantities.

The first to run was the Boeing Model 500, a two-burner turbojet developing 140 lb. (63.5 kg.) thrust at 36,000 r.p.m. This engine is suitable as a starter engine for larger jets or turbines, and may also be used as a thrust source for missiles, glide-bombs and small aircraft.

Some later engines make use of the gas-producing section of the Model 500 and have been adapted for shaft-drive on the Model 502-10C and -10F, or compressed-air output on the Model 502-11B. The Boeing 502-10C and -10F gas-turbine engines are developments of the earlier production engine, the Model 502-2E, and the 502-10F is being developed as a power plant for target drones. The 502-11B is a development of the 502-7D with increased air-horsepower output and is used in a starter unit developed for the support of the Boeing B-52 eight-jet bomber.

New engines include the Boeing 514, a 5.5 : 1 compression ratio shaft-turbine designed for ground power or airborne auxiliary use, and the 400 h.p. T60-BO-2 turboprop which is under development for the U.S. Navy Bureau of Aeronautics for helicopter applications.



The 400 s.h.p. Boeing Model 520-2 (T60) Turboprop engine.

More than 700 Model 502 engines have been produced, including an unspecified number which have been supplied to the U.S. Navy Bureau of Ships to power generators in minesweeping vessels and to propel landing craft. Model 502 engines have also been used experimentally to power personnel boats, light aircraft, helicopters, road trucks, railway shunting locomotives and stationary pumps and generators.

The Boeing Models 502-10C and 502-11B were described in the 1956-57 edition of "All the World's Aircraft." Details of the current engines which are available or under development as primary power plants for aircraft are given hereafter.

THE BOEING MODEL 520-2.
U.S. Navy designation: T60-2.

TYPE.—Centrifugal-flow Turboprop engine.

AIRSCREW DRIVE.—Single-stage helical reduction gear, ratio 4.4 : 1. Drive from free-turbine. Boeing slipper bearing.

AIR INTAKE.—Rectangular intake on each side of engine. No provision for de-icing. Inlet air flow 5.5 lb./sec. (2.49 kg./sec.).

COMPRESSOR.—Single-stage centrifugal type. Impeller is double-sided 14 ST forging with 38 vanes each side, and is splined to shaft. Casing is an aluminium casting. Shaft runs in special journal bearings. The diffuser is of the straight channel type.

COMBUSTION CHAMBERS.—Two reverse-flow can-type chambers, with outer casing of AISI 321 and N 155 flame tube. Dual-orifice atomizing fuel nozzles in flame tube domes. Capacitor discharge igniters on lower side of combustion chambers.

FUEL SYSTEM.—High-pressure speed-sensing type.

FUEL GRADE.—JP-4 or JP-5.

NOZZLE GUIDE VANES.—Radial and axial type, with 20 and 31 vanes respectively, made from AISI 310.

TURBINE.—Two independent stages, consisting of a radial compressor-turbine and axial power-turbine. Discs made of Inconel X and 16-25-6 steel. Compressor turbine is welded to shaft; power-turbine is shrunk on. Shaft runs in special journal bearing. Blades of power turbine (58 in number) are of HS 31 and are welded to disc. Gas temperature 1,525°F. before turbine, 900°F. after turbine.

ACCESSORY DRIVES.—At front of engine, driven by spur gear train from compressor.

LUBRICATION SYSTEM.—Pressure-type system with vane-type pressure and scavenge pump. Oil capacity 1⅛ U.S. gallons (5.4 litres). Normal oil supply pressure 60 lb./sq. in. (4.22 kg./cm.²).

OIL SPECIFICATION.—MIL-O-7808.

MOUNTING.—Three-point suspension. Two pads on sides of output section and one on accessory section.

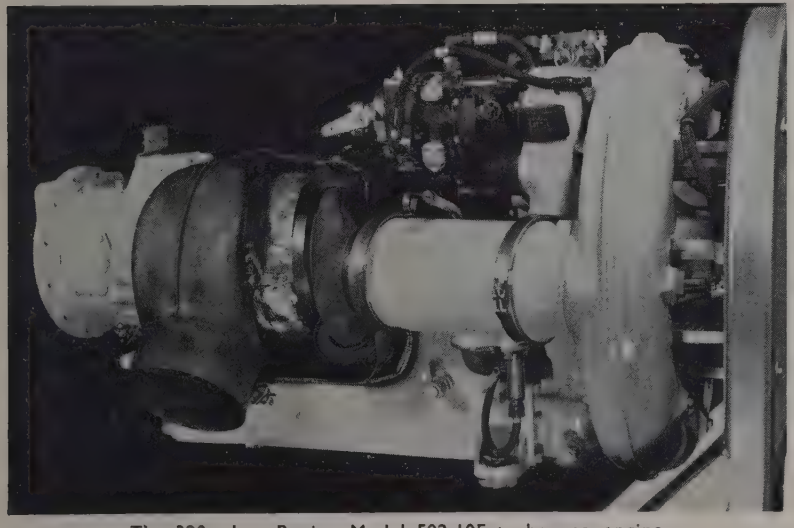
STARTING.—Electric starter.

DIMENSIONS.—
Diameter 23.62 in. (600 mm.).
Length overall 60.0 in. (1,525 mm.).

WEIGHT.—
Dry 360 lb. (163 kg.).

PERFORMANCE RATINGS.—
Military rating 400 s.h.p. at 6,200 r.p.m.
Normal rating 350 s.h.p. at 6,000 r.p.m.

CONSUMPTIONS.—
Fuel at military rating 0.72 lb./s.h.p./hr. (0.33 kg./s.h.p./hr.).
Fuel at normal rating 0.76 lb./s.h.p./hr. (0.34 kg./s.h.p./hr.).



The 320 s.h.p. Boeing Model 502-10F turboprop engine.

THE BOEING MODEL 502-10F.

TYPE.—Centrifugal-flow turboprop engine.

AIRSCREW DRIVE.—Three countershaft compound-type reduction gear, ratio 8.9 : 1. Driven from free turbine. Boeing slipper bearing.

AIR INTAKE.—Axial-type at end of engine. No provision for de-icing. Inlet air flow 4.24 lb./sec. (1.92 kg./sec.).

COMPRESSOR.—Single-stage centrifugal type. Single-sided impeller of 2014-T4 aluminium with 19 vanes, splined to shaft. Cast aluminium casing. Shaft runs in floating sleeve bearing. Straight channel diffuser.

COMBUSTION CHAMBERS.—Two straight-through-flow can type. Cast aluminium outer casing, with flame tube of N 155. Simplex atomizing burners in flame tube domes. Capacitor discharge igniters on lower side of chambers.

FUEL SYSTEM.—High-pressure speed-sensing type. Positive displacement pump, flyball governor and acceleration limiter. Maximum fuel pressure 900 lb./sq. in. (63.3 kg./cm.²).

FUEL GRADE.—JP-4, diesel oil or non-leaded gasoline.
NOZZLE GUIDE VANES.—Two rows of axial vanes, with 31 vanes in first stage and 29 in second stage. First-stage blades of HS 31, second stage blades of AISI 310.
TURBINE.—Two independent single-stage axial-flow turbines. Turbine discs of 16-25-6 steel. First-stage disc welded to shaft, second-stage disc shrunk on. Shaft runs in 3-bearing shaft floating-sleeve bearing. Compressor turbine has 66 blades of HS 31, power turbine has 50 blades of HS 21. All blades are welded to discs. Gas temperature 1,720°F. before turbine, 1,180°F. after turbine.
ACCESSORY DRIVES.—Three AND 2005 pods, for tachometer, governer and spare.
LUBRICATION SYSTEM.—Pressure-type system with vane-type pressure and scavenge pump. Oil capacity 1.5 U.S. gallons (5.7 litres). Normal oil supply pressure 20-40 lb./sq. in. (1.41-2.81 kg./cm.^{2}).
OIL SPECIFICATION.—SAE 10 (MIL-O-2104).
MOUNTING.—Cantilevered from compressor casing.
STARTING.—Electric starting through accessory drive train.
DIMENSIONS.—
Diameter 24.25 in. (616 mm.).
Length overall 41.50 in. (1,054 mm.).
WEIGHT.—
Complete with accessories 300 lb. (136 kg.).
PERFORMANCE RATING.—
Normal output 320 s.h.p. at 3,400 r.p.m.
CONSUMPTIONS.—
Fuel 0.92 lb./h.p./hr. (0.42 kg./h.p./hr.).
Oil 1 U.S. quart (0.95 litres) per 15 hrs. operation.

CONTINENTAL

CONTINENTAL AVIATION AND ENGINEERING CORPORATION, GAS TURBINE DIVISION.

HEAD OFFICE AND WORKS: 12700, KERCHEVAL AVENUE, DETROIT 15, MICHIGAN.

President: C. J. Reese.

Executive Vice-President and General Manager: A. W. Wild.

Secretary: Frederick H. Faust.

Treasurer: H. M. Parker.

Continental Aviation and Engineering Corporation, a subsidiary of Continental Motors Corporation, was formed in 1940 to serve as a research and development division of Continental Motors. It holds a licence to manufacture the French Turbomeca range of gas turbine engines.

THE CONTINENTAL MODEL 352.
U.S. Air Force designation: J69-T-9.

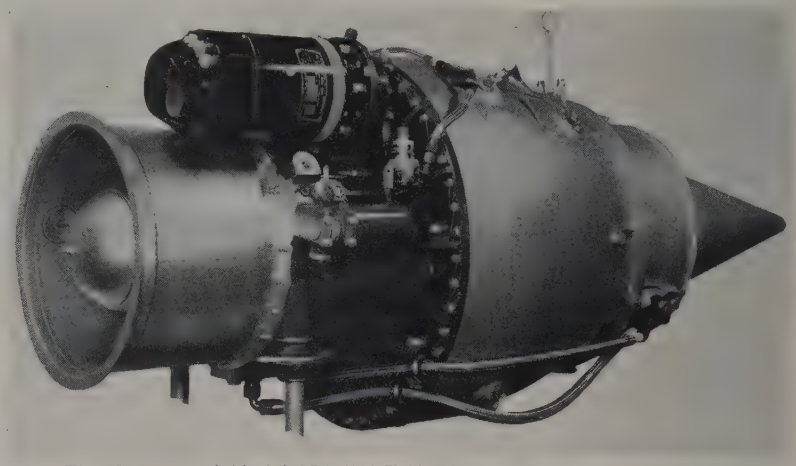
The J69 is basically the Turbomeca Marboré II which has been developed to meet American requirements. The J-69-T-9 version is a "long-life" engine and is in production for installation in the Cessna T-37 jet trainer, and is also fitted to the Beechcraft Jet Mentor and Temco TT-1 Pinto trainers.

The J69, which produces about 4 per cent. more thrust than the French engine, has provision for the installation of American accessories of larger types than are used on the Marboré II.

For a general description of the Marboré II see under "Turbomeca" (France).

DRY WEIGHT.—
364 lb. (165.2 kg.).

RATINGS.—
Take-off 920 lb. (420 kg.) s.t. at 22,700 r.p.m.
Normal output 725 lb. (330 kg.) s.t. at 21,000 r.p.m.
90 per cent. normal output 650 lb. (295 kg.) s.t. at 20,300 r.p.m.



The Continental Model 354 (J69-T-19B Lightweight turbojet engine.

THE CONTINENTAL MODEL 354.
U.S. Air Force designation: J69-T-19B.

The J69-T-19B is similar to the Model 352 but is a "short-life" engine intended for missile and target drone installations. It powers the Ryan Q-2A Firebee drone. The basic differences between the Models 352 and 354 concern accessories and their arrangement.

DRY WEIGHT.—
317 lb. (143.9 kg.).

RATINGS.—
Take-off 1,060 lb. (481 kg.) s.t.
Normal 860 lb. (390 kg.) s.t.

FUEL CONSUMPTIONS.—
Take-off 1.27 lb./lb. s.t./hr. (1.27 kg./kg. s.t./hr.).
Normal 1.25 lb./lb. s.t./hr. (1.25 kg./kg. s.t./hr.).

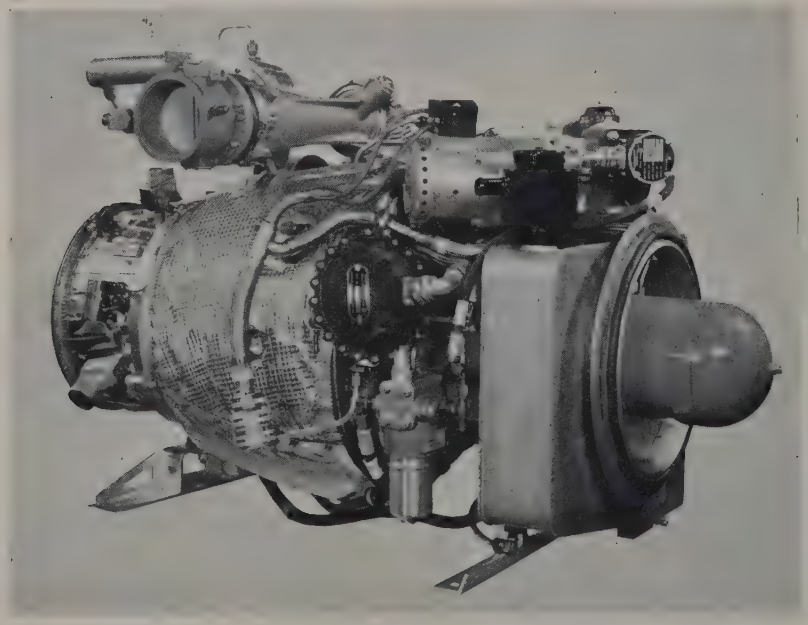
THE CONTINENTAL MODEL 141.

The Model 141 is a gas-turbine-driven air generator which has been developed from the Turbomeca Palouste. It is embodied in a trailer-mounted unit (U.S.A.F. MA-1A) for ground starting of jet aircraft; but is suitable also for installation in pressure-jet helicopters and has been chosen for this application in experimental and projected designs.

WEIGHT.—
197 lb. (89.35 kg.).

PERFORMANCE.—
Air h.p. (standard conditions) 191.
Air h.p. (130°F. air temperature) 182.
Air delivery (standard conditions) 2.2 lb./sec. (0.99 kg./sec.).
Air delivery pressure (standard conditions) 52.5 lb./sq. in. (3.69 kg./cm.^{2}).

CONSUMPTION.—
Fuel 287 lb./hr. (130 kg./hr.).



The Continental Model 141 air generator.

THE CONTINENTAL MODEL 160.

Model 160 is the Continental designation for the Turbomeca Autan turbo-compressor, which is scheduled for further development and application by Continental. For a full description see under "Turbomeca" (France).

THE CONTINENTAL MODEL 220-2.
U.S. Air Force designation: XT51-T-3.

This 425 h.p. shaft turbine is a development of the Turbomeca Artouste II, and has been installed experimentally in the Sikorsky XH-39 helicopter. Other applications are under development.

THE CONTINENTAL MODEL 320.

Pending new applications and development, the Model 320 turbojet engine (350 lb. = 159 kg. s.t.) remains similar to the Turbomeca Palas, of which a description appears under "Turbomeca" (France).

THE CONTINENTAL MODEL 324.

Pending new applications, the Model 324 turbojet engine (550 lb. = 250 kg. s.t.) remains basically the same as the Turbomeca Arbizon, of which a description appears under "Turbomeca" (France).

FAIRCHILD

FAIRCHILD ENGINE DIVISION, FAIRCHILD ENGINE AND AIRPLANE CORPORATION.

ENGINE DIVISION, HEAD OFFICE AND WORKS: DEER PARK, LONG ISLAND, N.Y.

Vice-President and General Manager: F. E. Newbold, Jr.

Assistant General Manager: E. M. Lester.

Director of Engineering: E. D. Bryant.

Chief Engineer: A. T. Gregory.

The Fairchild Engine Division is engaged in power-plant research and development work for the United States Air Force and the United States Navy Bureau of Aeronautics and the Bureau of Ordnance.

This work includes the development and production of gas-turbine engines for both piloted and pilotless aircraft and guided missiles, and design and development work on other high-performance lightweight engines. In addition, Fairchild is manufacturing the V-32 D-2 auxiliary power-plant, comprising a reciprocating engine and generator, which is used in virtually every American military aircraft in the bomber and transport classes.

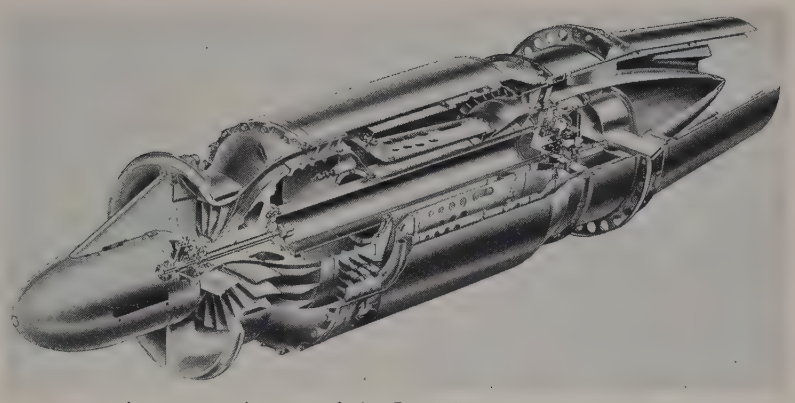
The only recent Fairchild aero-engines of which brief details may be given are the J44 turbojet which is being produced for both the U.S. Navy and Air Force, and the XJ83 small lightweight high-performance jet engine for the U.S.A.F.

THE FAIRCHILD XJ83.

The XJ83 in its initial form is an entirely new high-performance small turbojet in the 2,000 lb. (908 kg.) s.t. class and is intended to power piloted aircraft as well as missiles. Its initial applications will be in the Canadair CL-41 trainer, a version of the Lockheed JetStar utility trainer and the Fairchild Goose missile. Weight of the early J83 is reported to be approximately 400 lb. (180 kg.).

THE FAIRCHILD J44.

The J44 is a small lightweight general-purpose turbojet engine which was designed originally to a 1947 U.S. Navy specification. Primarily it is intended to power target drones and guided missiles, and its first announced use was as the power-plant of the Ryan Firebee high-speed pilotless target aircraft. It now powers Fairchild's own Petrel AUM missile, and has been developed to the stage where it is also suitable for use in piloted aircraft. The Bell VTOL vertical take-off aircraft which first flew in 1954 was powered by two J44 engines.



A cut-away drawing of the Fairchild J44 turbojet engine.

The J44, which is designed to be a self-contained power-plant needing only a minimum of services from the airframe, features an outer sheet metal monocoque shell which forms both a pressure chamber and a frame structure connecting the two main bearing supports. Its smooth outer shell, which carries the main stresses of the engine, eliminates the need for additional cowling in certain types of installations.

The J44 is the first jet engine in its power and weight class to receive an Approved Type Certificate from the Civil Aeronautics Administration.

Four versions of the J44 have so far been announced:—

J44-R-20B and -24. "Short-life" production version for missile and drone use.

J44-R-3. Developed "long-life" version, with stainless steel combustion chambers and nozzle guide vanes. Used to augment the main power plants of piloted aircraft.

J44-R-26. Powers Firebee drone and Petrel missile. Increased thrust.

FT-101E. Commercial variant of J44-R-3 (certificated).

TYPE.—Lightweight turbojet.

AIR INTAKE.—Annular type surrounding nose bullet.

COMPRESSOR.—Mixed-flow type. Single-sided impeller with 22 vanes, made in two parts with forged aluminium front half and forged magnesium rear half. Impeller bolted to shaft which is carried on ball bearings. Cast aluminium casing. Compression ratios 2.47 (R-3 and FT-101E), 2.5 (R-20, 24) and 3.25 (R-26).

COMBUSTION CHAMBER.—Annular type, made of inconel on J44-R-3 and stainless steel on J44-R-20.

IGNITION.—Dual coil and single igniter on J44-R-3. Single coil and igniter on J-44-R-20.

FUEL SYSTEM.—Maximum fuel pressure 350 lb./sq. in. (24.6 kg./cm.²).

FUEL GRADE.—JP fuels or gasoline.

NOZZLE GUIDE VANES.—Thirty-seven Stellite 21 vanes and inconel bands (J44-R-3). Stainless steel bands and vanes (J44-R-20).

TURBINE.— Single-stage turbine. Forged steel alloy disc bolted to shaft which runs on a rear roller bearing in the J44-R-20B and a rear ball bearing on the J44-R-3. Forty-six AMS-5382 blades welded (J44-R-3) or mechanically attached (J44-R-20B) to periphery of disc. Gas temperature aft of turbine 1,325°F. (716°C.) maximum.

JET PIPE.—Fixed type. AMS-5542 steel cone. Stainless steel jet pipe.

ACCESSORIES. — Self-contained accessory section in nose bullet, containing fuel pump, starter, electric generator and tachometer drive. Can be quickly removed or replaced, or individual accessories can be removed from their mounting pads, only one special tool—a shaft-nut wrench—being required for all accessory servicing.

LUBRICATION.—Front and rear bearings lubricated by oil mist system, accessories section by oil sump. Capacities: oil mist 400 cc., accessories section 350 cc. Operating pressure 0.35 lb./sq. in. (0.025 kg./cm.²).

OIL SPECIFICATION.—Land operation MIL-O-6081 GR 1010. Overwater operation MIL-C-6529 Type III.

MOUNTING.—Cantilever or single-point trunnion mounting.

STARTING.—Jack and Heintz D62-1 electric starter (J44-R-3) or Breeze VG460 starter-generator (J44-R-20B).

DIMENSIONS (J44-R-3 and FT-101E).—
Diameter 24.3 in. (617 mm.).
Length 90.4 in. (2,296 mm.).

DIMENSIONS (J44-R-20B and 24).—
Diameter 24 in. (610 mm.).
Length 88 in. (2,235 mm.).

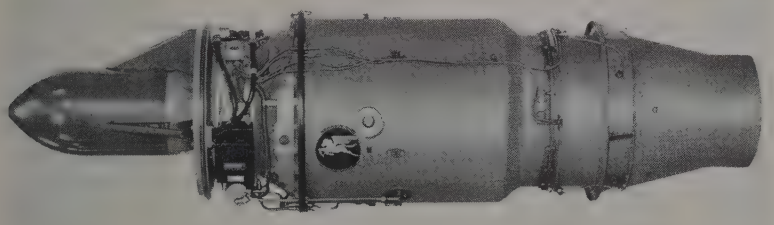
DIMENSIONS (J44-R-26).—
Diameter 22.3 in. (566 mm.).
Length 92 in. (2,337 mm.).

WEIGHTS DRY (less tailpipe).—
J44-R-3 and FT-101E 380 lb. (172 kg.).
J44-R-20B and -24 348 lb. (158 kg.).
J44-R-26 365 lb. (166 kg.).

PERFORMANCE RATING (J44-R-3, -20B and -24 and FT-101E).—
Static thrust 1,000 lb. (454 kg.) at 15,780 r.p.m.

PERFORMANCE RATING (J44-R-26).—
Static thrust 1,100 lb. (500 kg.).

CONSUMPTIONS.—
Fuel (J44-R-3 and FT-101E) 1.55 lb./lb. thrust/hr. (1.55 kg./kg. thrust/hr.).
Fuel (J44-R-20B and 24) 1.65 lb./lb. thrust/hr. (1.65 kg./kg. thrust/hr.).
Fuel (J44-R-26) 1.30 lb./lb. thrust/hr. (1.30 kg./kg. thrust/hr.).
Oil (J-44-R-3) 0.3 lb./hr. (0.136 kg./hr.).
Oil (J44-R20-B) 0.625 lb./hr. (0.283 kg./hr.).



The Fairchild J44 Lightweight turbojet engine.

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY. AIRCRAFT GAS TURBINE DIVISION.

HEAD OFFICE: CINCINNATI 15, OHIO.

General Manager: J. B. Montgomery.

Counsel: C. F. Steele.

Jet Engine Department.

General Manager: G. Neumann.

Production Engine Department.

General Manager: N. E. Firestone.

Flight Propulsion Laboratory Department.

General Manager: D. Cochran.

Small Aircraft Engine Department (Lynn, Mass.).

General Manager: G. C. Shafer.

Aircraft Accessory Turbine Department (Lynn, Mass.).

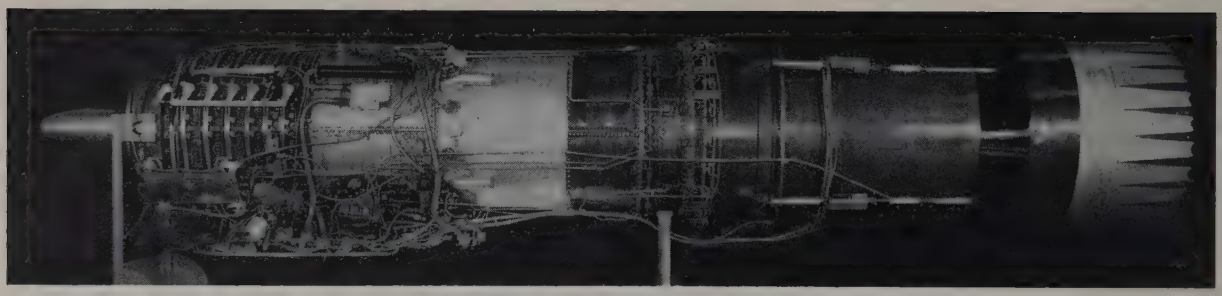
General Manager: W. C. O'Connell.

The General Electric Company entered the gas-turbine field about 1895. Years of pioneering effort by the late Dr. Sanford A. Moss produced the aircraft turbo-supercharger, successfully tested at height in 1918 and mass-produced in World War II for U.S. fighters and bombers.

The company built its first aircraft gas-turbine in 1941, when it began development of Whittle-type turbojets, under an arrangement between the British and American Governments.

Since that time, General Electric has produced a series of successful designs. Production and development responsibility for two of them, the J33 and J35, was transferred to the Allison Division of General Motors after the war.

Of the others, the J47 powers the



The General Electric J79 turbojet with afterburner (18,000 lb.=8,165 kg. s.t.).

Boeing B-47 and RB-47, North American F-86D, F-86E, F-86F, F-86K, F-86L and FJ-2, and the Convair B-36; and the J-73 powers the F-86H. Production of both the J47 and J73 was completed early in 1956.

General Electric's current production engine is the J79, with the T64, T58, J85, J93 and a series of rocket motors under development. The J79 powers the Lockheed F-104. Convair B-58, Grumman F11F-1F and the Chance Vought Regulus II missile. A commercial version designated the CJ-805, will power the Convair 880 transport.

The new T58 small free-turbine engine has been flight tested in Sikorsky S-58 and Vertol H-21 helicopters and has been chosen to power the Kaman HU2K-1, Sikorsky S-61 and Sikorsky S-62 helicopters.

In 1952 an Aircraft Accessory Turbine Department was established to handle the development, manufacture and sale of aircraft accessory power equipment. Its current products include constant-speed generator drives for the Boeing B-52, Douglas A4D and Convair 880; turbo-pumps for the B-52; turbo-starters for the Martin B-57 and McDonnell F-101B; afterburner fuel pumps for the North American F-86D; turbo-drives for the North American X-15 and turbo-superchargers for many civil and military aircraft.

In November, 1951, General Electric established a Development Operation within its Aircraft Gas Turbine Division. Later, this operation became the Development Department, which, in 1956, was renamed the Flight Propulsion Laboratory Department, one of five Departments making up the AGT Division.

The Flight Propulsion Laboratory is not committed to providing support for the current line of production engines. It is responsible for creating new concepts of flight propulsion, to demonstrate the feasibility of new materials and components and, as required, to demonstrate new and complete propulsion systems. Ordinarily, the Department is concerned with components and systems well in advance of production. After it has demonstrated the feasibility of new product lines, these are transferred to the appropriate product Departments for manufacture in quantity.

The Department has extensive research and development facilities both at Evendale, Ohio and Lynn, Mass., for doing applied research, developing new materials and demonstrating new engineering principles. It creates and operates major development test facilities for the Division and supports the other Departments by carrying out assigned engineering and other tasks.

Currently, the Flight Propulsion Laboratory Department is investigating air-breathing engines for high Mach numbers. These are intended for use as booster units in missiles and space vehicles, and for special purposes, such as VTOL and STOL aircraft. The Department is also investigating advanced rocket engines, as well as propulsion systems for space and orbital flight.

THE GENERAL ELECTRIC J93.

No details of the J93 have yet been released officially; but it will power the forthcoming North American B-70A Mach 3 bomber, which is believed to make some use of chemical fuels.

THE GENERAL ELECTRIC J85.

Originally designated MX2273, the J85 turbojet is being developed by the G.E. Small Aircraft Engine Department under a U.S.A.F. contract. It was intended originally as an engine for pilotless aircraft, but a "long-life" version is also under development, with and without afterburner, for use in piloted aircraft. It will be used first to power the Northrop T-38 supersonic trainer.

THE GENERAL ELECTRIC J79.

The J79 turbojet is the first high-compression variable-stator engine built in the United States. It has several rows of variable-incidence compressor stator blades, the setting of each row being adjusted by rams moved by engine fuel to achieve optimum air flow angles for each stage at all engine speeds. It also has constant-speed characteristics.

Production is facilitated by the fact that the J79 is made largely of steel, with a minimum of difficult-to-obtain materials. Its rotor runs in only three bearings.

The J79-GE-3, as fitted in the Lockheed F-104 and tested in a modified Douglas F4D naval interceptor, has an afterburner to ensure a combination of very high thrust at high Mach numbers with comparative economy at subsonic speeds. This engine completed successfully its first 50-hour type test in August, 1955.

Later versions, with turbine diameter increased by some 2 in. (5 cm.), have 6% greater thrust and lower specific fuel consumption.

The J79 also powers the Convair B-58 Hustler, Grumman F11F-1F Tiger and Chance Vought Regulus II surface-to-surface missile.

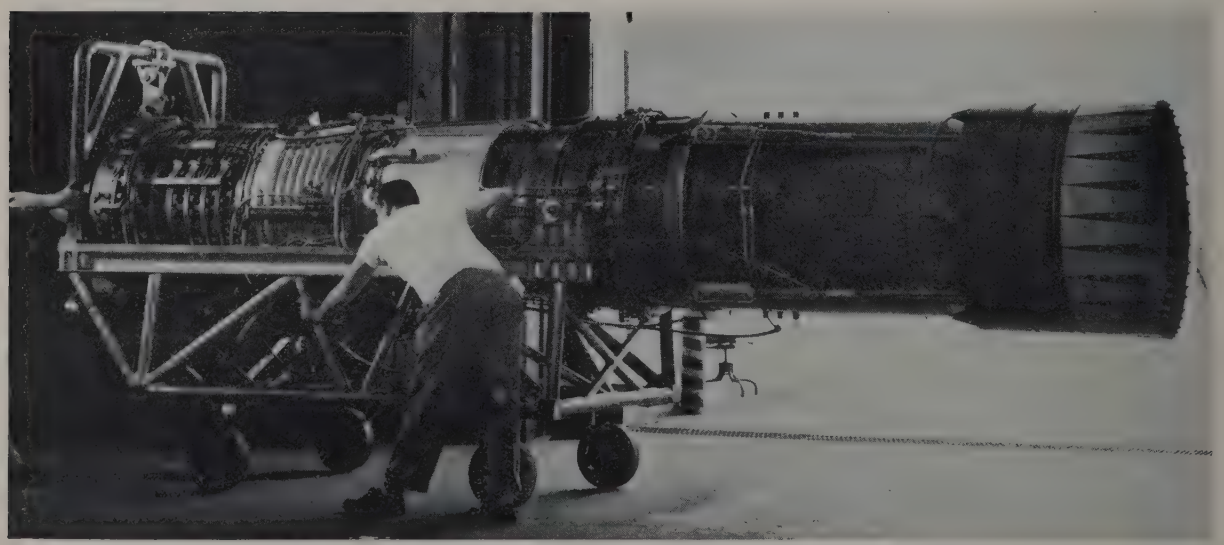
TYPE.—Variable-stator axial-flow turbojet.

AIR INTAKE.—Annular type, surrounding central bullet fairing. Struts and inlet guide vanes anti-iced with compressor discharge air.

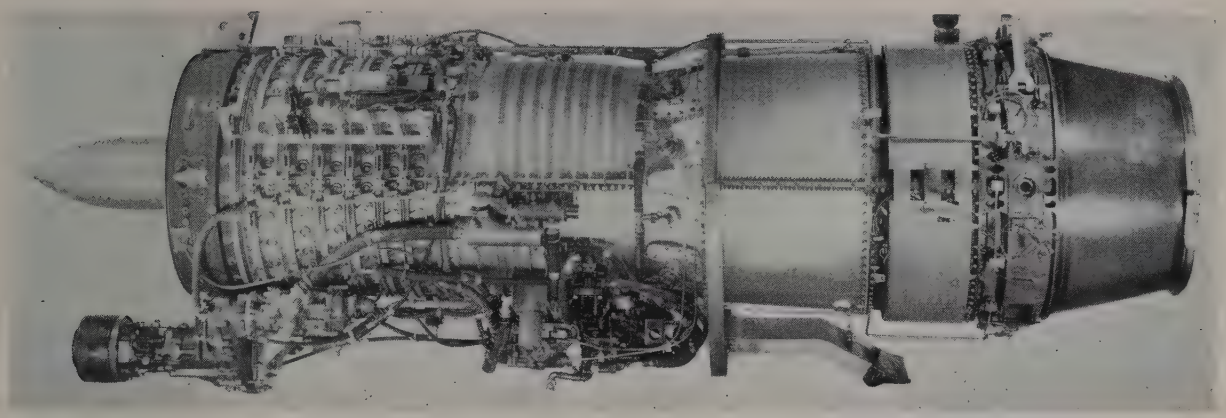
COMPRESSOR.—Seventeen-stage axial-flow. First six stator stages and the inlet guide vanes have variable-incidence. Rotor consists of thin webbed discs and spacer rings, bolted together, with blades dovetailed into rims. Compressor casing made in two easily-removable halves. Compression ratio 12 : 1. Air mass flow 162 lb./sec. (73.5 kg./sec.).

COMBUSTION CHAMBER.—Annular type with 12 injectors. Dual ignition.

FUEL SYSTEM.—Power control system has two separate and distinct fuel systems, termed the main fuel system and afterburner fuel system. Main system is con-



The General Electric J79 turbojet engine and afterburner with variable nozzle.



The General Electric CJ-805-3 (11,000 lb.=5,000 kg. s.t.), the civil version of the J79.

trolled by main fuel controller, which is a flow-controlling unit. The afterburner system is controlled by an independent controller, also of the flow-controlling type.

TURBINE.—Three-stage axial-flow type. Turbine wheels coupled to compressor rotor by a conical shaft. Lightweight casing of fabricated sheet steel in two easily-removable halves.

CONTROLS.—Hydro-machanical control system with electrical trim, all hydraulic and electrical power being supplied by engine. Integrated and synchronised composite system consists of main and afterburner fuel systems, emergency system (fighter models only), nozzle-area control system and the variable stator control system which is integrated with the main fuel control.

MOUNTING.—Pads provided for a variety of mounting arrangements, depending on airframe requirements.

AFTERBURNER.—Short 2,000°K. type with fully-variable nozzle.

DIMENSIONS (J79-GE-1).—
Diameter of engine 32.5 in. (825 mm.).
Diameter of afterburner nozzle 36 in. (915 mm.).
Length with afterburner 204 in. (5,180 mm.).

WEIGHT (J79-GE-1).—
Dry weight 3,190 lb. (1,446 kg.).

PERFORMANCE RATING.—
Take-off (static) with afterburner 18,000 lb. (8,165 kg.).

THE GENERAL ELECTRIC CJ-805-3.

The CJ-805 is a commercial version of the J79, previously described. It will power the Convair 880 transport and has been extensively bench-run. Flight tests began in April, 1958 in a modified Douglas XF4D-1 Skyray aircraft.

The initial production version is designated CJ-805-3 and is rated in the 11,000 lb. (5,000 kg.) s.t. class. It will be equipped with a noise suppressor and a thrust reverser to give 5,000 lb. (2,270 kg.) reverse thrust.

DIMENSIONS.—
Max. diameter 36.6 in. (930 mm.).
Length 110.3 in. (2,800 mm.).

THE GENERAL ELECTRIC CJ-805-21.

The CJ-805-21 is a turbo-fan version of the CJ-805 turbojet, in which a large-diameter fan is mounted behind the gas-generator as a self-contained and mechanically-independent unit, so making possible the conversion of existing CJ-805 turbojets into turbo-fan engines.

The single-stage fan comprises an inner turbine, working in the hot gas stream, with an outer row of blades around the periphery, working in the atmospheric air. By ducting the cool air from the outer blades around the tail-pipe to join the hot exhaust gases, some of the energy of the hot gases is removed, leading to a greatly-reduced noise level as well as to increased thrust and an estimated 8-12% improvement in specific fuel consumption. It is hoped to obtain C.A.A. certification of the CJ-805-21 by 1960.

The CJ-805-21 has been chosen to power the Convair 600 transport.

THE GENERAL ELECTRIC T64.

The T64 is a "convertible" gas turbine engine which is under development by the G.E. Small Aircraft Engine Department for the U.S. Navy Bureau of Aeronautics.

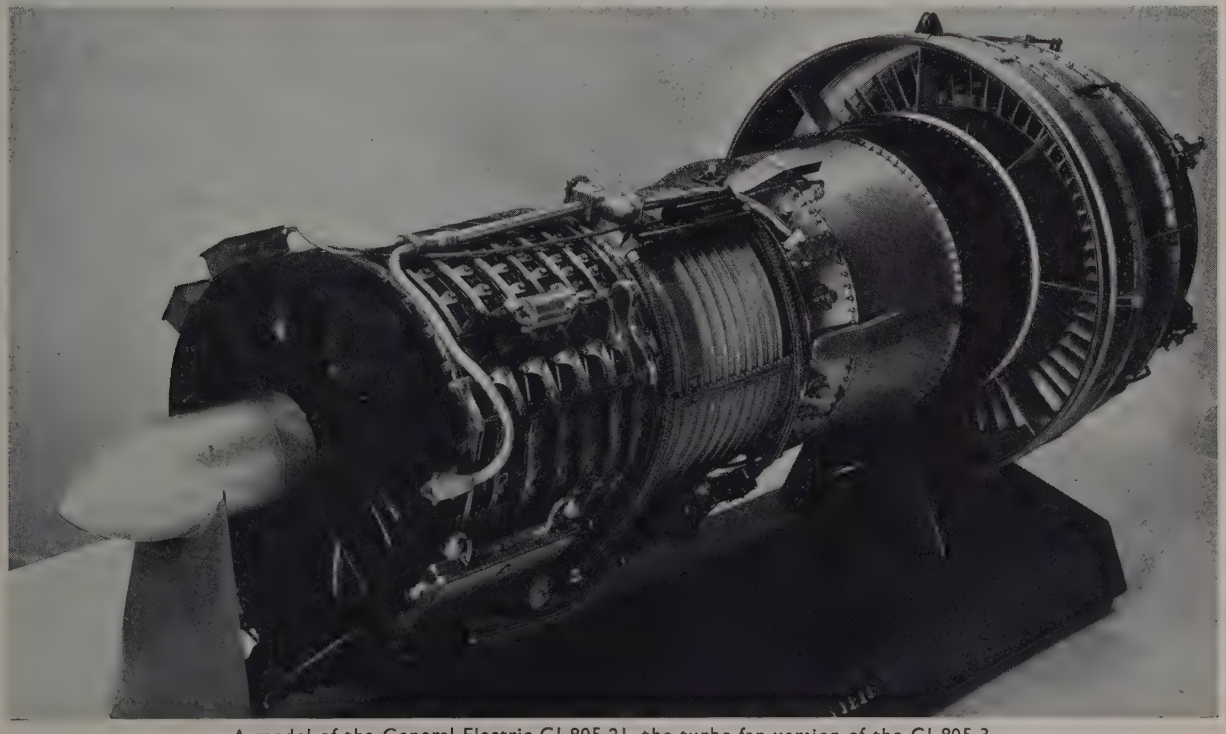
Its convertibility arises from the fact that the basic gas turbine power section can be equipped with a remote reduction-gear, helicopter controls and torquemeter to become a shaft engine, or it can be provided with an airscrew reduction-gear, airscrew brake and interchangeable bolt-on control unit to become a turbo-prop engine.

It is envisaged for use in helicopters, STOL aircraft and convertiplanes. Both versions of the T64 are designed to operate with their axes either vertical or horizontal, or at any intermediate angle.

The engine is said to be in the 2,600 s.h.p. class and to have a power/weight ratio of better than 3 : 1. No further details are available.

THE GENERAL ELECTRIC T58.

The T58 is a small free-turbine power-unit which is being developed by the company's Small Aircraft Engine Department for the Bureau of Aeronautics, U.S. Navy.



A model of the General Electric CJ-805-21, the turbo-fan version of the CJ-805-3

The engine is intended primarily as a power-unit for helicopters and the U.S. Navy have stated that their future helicopter plans centre around the T58. But it may also be developed for small fixed-wing aircraft in the form of a turboprop when combined with airscrew reduction gear; as an auxiliary boost unit for large military and commercial aircraft; and for marine, army tank and industrial use.

Hydro-mechanical constant speed control featured in the T58 is expected to be particularly valuable in helicopter applications. It will maintain essentially constant rotor speed by regulating the engine power automatically and eliminating the need for speed adjustment by the pilot during normal operation.

Two T58 turbines have been installed in the nose of a Sikorsky HSS (S-58) helicopter for flight testing and this aircraft flew for the first time on January 30, 1957. In addition, a Vertol H-21C helicopter has been equipped with two T58 turbines in place of its normal single piston-engine, and is re-designated H-21D. It flew for the first time in September, 1957.

First aircraft designed from the start around the T58 engine is the new Kaman HU2K-1 utility helicopter. In addition, the Sikorsky S-62, a turbine-powered development of the S-55, has a single T58 as its power plant.

Two versions of the T58 have been announced :—

T58-GE-2. Initial version, rated at 1,024 s.h.p. Completed official 150-hour type test in September, 1957 at rating of 1,065 s.h.p., with S.F.C. of 0.655.

T58-GE-6. Developed version, rated at 1,050 s.h.p. New features include power take-off in any one of three positions, forward or aft; optional main reduction gear, three-position exhaust; torque sensor; ability to operate on JP-4 or JP-5 fuel.

Type.—Free-turbine shaft turbine.

Air Intake.—Annular intake casting with four hollow radial struts supporting central housing for starter drive clutch and front main roller bearing. Casing and struts heated by air bled from compressor.

Compressor.—Ten-stage axial-flow. Variable-incidence inlet guide vanes. First three of the eleven rows of stator blades also have variable-incidence. Casing divided into upper and lower halves. Compression ratio more than 8 : 1. Air mass flow 12.4 lb./sec. (5.62 kg./sec.) at 26,300 r.p.m.

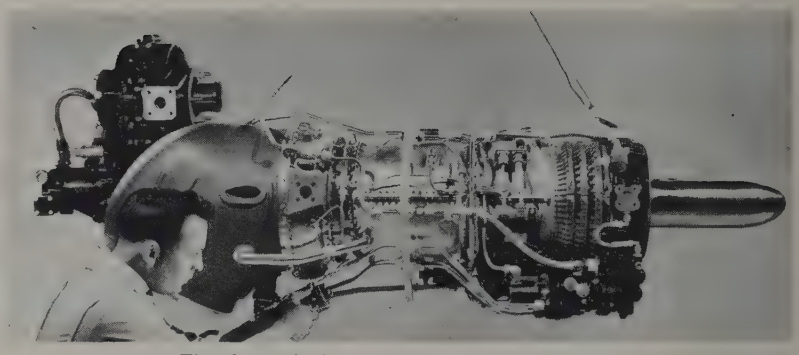
Combustion Chamber.—Annular type. Sixteen fuel nozzles (eight on each of two manifolds) mounted on front of inner liner. One capacitor discharge type igniter, operated only during starting cycle. Outer casing in two halves to facilitate inspection.

Gas Generator Turbine.—Two-stage short-chord axial-flow type, coupled directly to compressor by hollow conical shaft. Centre ball thrust bearing, rear roller bearing. Cooling by air bled from compressor. Temperature before turbine approximately 1,600°F.

Power Turbine.—Single-stage axial-flow type, mechanically independent of gas generator turbine. Operated nominally at 19,500 r.p.m., reduced to 6,000 r.p.m. by reduction gear.

Main Reduction Gear (optional).—Gearbox with integral lubrication system. Reduces power turbine speed to 6,000 r.p.m. Fore or aft power take-off capability in three positions.

Jet Exhaust.—Three positions, vertically down, 90° left or right.



The General Electric T58 free-turbine engine.

Controls.—Free turbine constant-speed control. Hydro-mechanical controls.

Accessory Drives. — Engine accessories driven partly by the compressor shaft. Airframe accessories mounted on free-turbine reduction gearbox or rotor hub.

Dimensions.—
Diameter 16 in. (406 mm.).
Length (T58-GE-2) 59 in. (1,499 mm.).
Length (T58-GE-6) 55 in. (1,397 mm.).

Weight (T58-GE-2).—
Without reduction gear 250 lb. (113 kg.).
With reduction gear 325 lb. (148 kg.).

Weight (T58-GE-6).—
Without reduction gear 267 lb. (121 kg.).
With reduction gear 342 lb. (155 kg.).

Performance Rating (T58-GE-2).—
Without reduction gear 1,050 s.h.p.
With reduction gear 1,024 s.h.p.
Max. continuous rating 875 s.h.p.

Performance Ratings (T58-GE-6).—
With reduction gear 1,050 s.h.p.
Max. continuous rating 900 s.h.p.

Consumption (T58-GE-2).—
Fuel 0.69 lb. (0.313 kg.) per s.h.p./hr. at max. continuous rating.

Consumption (T58-GE-8).—
Fuel 0.67 lb. (0.304 kg.) per s.h.p./hr. at max. continuous rating.

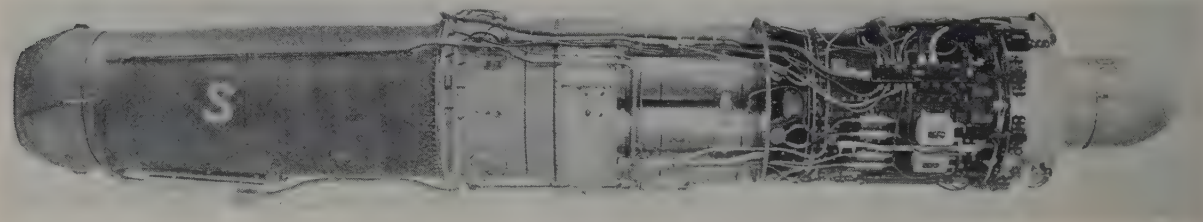
THE GENERAL ELECTRIC J47 SERIES.

The following are some of the models of the J47 installed in current U.S.A.F. aircraft :—

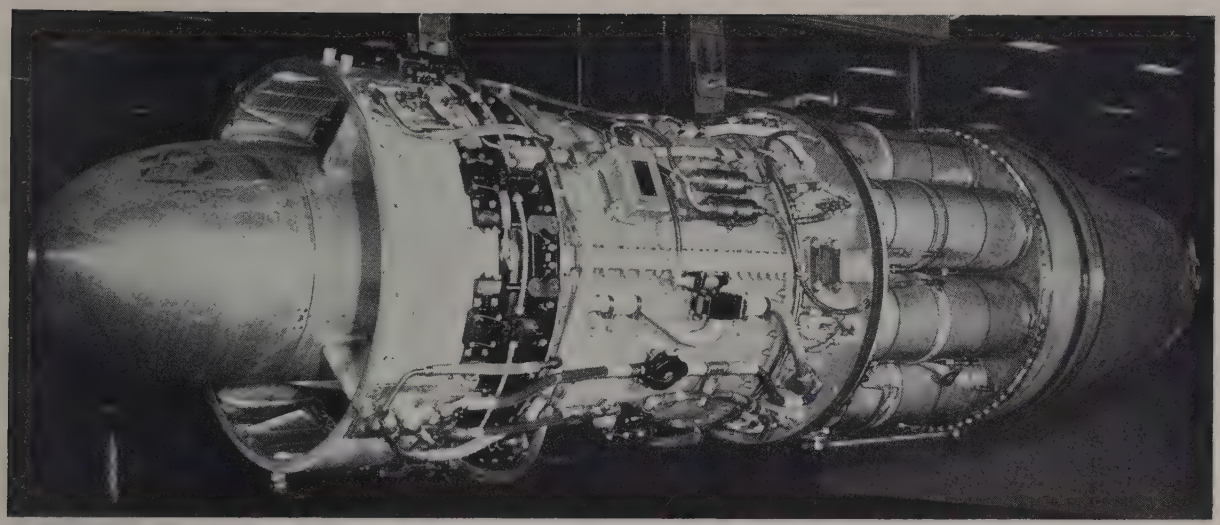
J47-GE-2. Installed in the North American FJ-2 Fury.

GENERAL ELECTRIC J47 ENGINE DATA.

Engine Model	S/L. Static Thrust (Dry)	S/L. Static Thrust (Augmented)	Normal Thrust	Dry weight with Components	Length with Tailcone	Maximum Diameter	Normal Fuel Consumption
J47-17B	5,425 lb. (2,463 kg.) at 7,950 r.p.m.	7,500 lb. (3,402 kg.) at 7,950 r.p.m.	4,490 lb. (2,038 kg.) at 7,950 r.p.m.	3,263 lb. (1,481.4 kg.)	228 in. (5,790 mm.)	36.75 in. (933 mm.)	1.13 lb./lb. s.t./hr. (1.13 kg./kg. s.t./hr.)
J47-23	5,880 lb. (2,670 kg.) at 7,950 r.p.m.	None	5,270 lb. (2,390 kg.) at 7,630 r.p.m.	2,516 lb. (1,142.3 kg.)	145 in. (3,683 mm.)	36.75 in. (933 mm.)	1.037 lb./lb. s.t./hr. (1.037 kg./kg. s.t./hr.)
J47-25A	5,970 lb. (2,710 kg.) at 7,950 r.p.m.	7,200 lb. (3,266 kg.) at 7,950 r.p.m.	5,320 lb. (2,413 kg.) at 7,630 r.p.m.	2,554 lb. (1,159.5 kg.)	145 in. (3,683 mm.)	36.75 in. (933 mm.)	1.028 lb./lb. s.t./hr. (1.028 kg./kg. s.t./hr.)
J47-27	5,970 lb. (2,710 kg.) at 7,950 r.p.m.	None	5,320 lb. (2,413 kg.) at 7,620 r.p.m.	2,607 lb. (1,183.5 kg.)	148 in. (3,759 mm.)	36.75 in. (933 mm.)	1.028 lb./lb. s.t./hr. (1.028 kg./kg. s.t./hr.)
J47-2	6,000 lb. (2,724 kg.) at 7,950 r.p.m.	None	5,350 lb. (2,427 kg.) at 7,630 r.p.m.	2,572 lb. (1,167.7 kg.)	148 in. (3,759 mm.)	36.75 in. (933 mm.)	1.025 lb./lb. s.t./hr. (1.025 kg./kg. s.t./hr.)
J47-33	5,550 lb. (2,517 kg.) at 7,950 r.p.m.	7,650 lb. (3,470 kg.) at 7,950 r.p.m.	5,100 lb. (2,313 kg.) at 7,950 r.p.m.	3,196 lb. (1,450 kg.)	228 in. (5,790 mm.)	36.75 in. (933 mm.)	1.13 lb./lb. s.t./hr. (1.13 kg./kg. s.t./hr.)



The General Electric J47-GE-17B axial-flow turbojet engine with afterburner.



The General Electric J47-GE-25A turbojet engine (5,970 lb.=2,710 kg. s.t. at sea level).

J47-GE-11. Installed in the Boeing B-47A and first 87 B-47B.

J47-GE-13. Installed in the North American F-86E and B-45C.

J47-GE-15. Installed in the North American B-45C.

J47-GE-17B. Installed in the North American F-86D, F-86K and F-86L. Basically the same as the -23 engine except fitted with afterburner and new electronic controls. Engine is completely anti-iced with hot air bled from compressor to air inlet guide vanes, fairings and support struts. Air inlet screen is retractable after take-off. Considerable reduction in use of strategic materials.

J47-GE-23. Installed in Boeing B-47B and RB-47B. Basically same as -17 but without afterburner, and hydraulic control instead of electronic.

J47-GE-25A. Installed in Boeing B-47E and RB-47E. Rated at 5,970 lb. (2,710 kg.) dry. Fitted with water/alcohol injection. Also built by Packard Motor Company and the Studebaker Corporation to G.E. design.

J47-GE-27. Installed in North American F-86F. Has lower fuel consumption than earlier J47-GE-13 and is anti-iced.

J47-GE-33. Installed in later production F-86D.

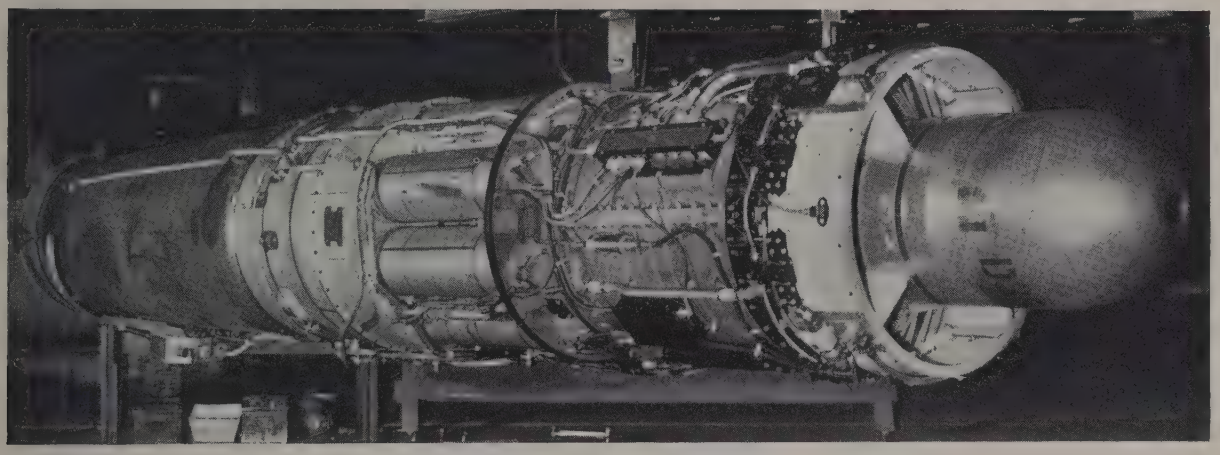
A full description of the J47 has appeared in previous editions of this Annual.

THE GENERAL ELECTRIC X-405.

The X-405 is a single-chamber rocket engine, designed to power the first stage of the "Project Vanguard" earth satellite rocket. Its chamber is gimbal-mounted for directional control. Propellents are liquid oxygen and a mixture of approximately 95% gasoline, 4% alcohol and 1% silicone oil for cooling. They are fed into the chamber by turbopumps.

DIMENSIONS.—
Length approx. 70 in. (1,780 mm.).

PERFORMANCE.—
Max. thrust approx. 27,000 lb. (12,250 kg.) for 140-150 sec.
Specific impulse approx. 240.
Efflux velocity approx. 7,780 ft./sec. (2,370 m./sec.).



The General Electric J47-GE-33 turbojet engine with afterburner.

HILLER

HILLER AIRCRAFT CORPORATION, PROPULSION DEPARTMENT.

HEAD OFFICE: 1350 WILLOW ROAD, PALO ALTO, CALIFORNIA.

President: Stanley Hiller, Jr.

Vice-Presidents: A. J. M. Chadwick, A. W. B. Vincent and D. W. Elam.

Chief Engineer: Robert Wagner.

Chief of Propulsion: Elbert Sargent.

The Hiller company began the development of ramjet engines in 1949 after the company had undertaken a study to determine ways of eliminating the costly items of the conventional rotary-wing aircraft. This study showed that the complexity and costs of the present-day helicopter were largely due to the transmission, drive and torque-compensating systems and all the intricate mechanisms of the reciprocating engine. It further showed that if power could be applied to the rotor tips a far more efficient helicopter could be developed.

Hiller began with the development and evaluation of various types of pulse-jet engines but soon concentrated on the simple ramjet, and by August, 1950 had made the first flight with its initial ramjet design in the original Hornet configuration.

Further improved engines were built and tested and in March, 1953, the first successful 200-hour duration test was completed with the 8RJ2B ramjet. The first flight of the HJ-1 Hornet helicopter fitted with two of these tip-mounted power-units was made in September, 1953.

Two further 150-hour endurance tests were made in February and September, 1954, and on October 22, 1954, Type Certificate No. 280 was awarded to the 8RJ2B ramjet engine, the first of its type to be approved by the C.A.A.

The 8RJ2B engine powers the military YH-32 and naval HOE-1 models of the Hornet.

THE HILLER 8RJ2B RAMJET.

The 8RJ2B ramjet is a complete unit intended for helicopter rotor tip mounting. It is comprised of a diffuser, a flameholder, a combustion chamber and an exit nozzle.

The body of the engine is made up of a series of shell segments formed of thin sheet which are welded to a heavier mounting plate forming the inboard centre section of the engine. This plate which tapers in section to approximately the shell thickness at the welds, provides a thick centre boss to which the blade attachment tab is butt-welded.

The inlet is faired by an inner liner forming a diffuser, and the exit nozzle is reinforced by a thick collar welded to the shell segments. A radial rearward-sloping "finger" type flameholder is located centrally in the aft section of the diffuser. It is made up of an inner segment riveted to the mounting plate and a removable outer segment which is secured to the inner segment by the fuel hub and fairing nut. The fuel nozzle is located at the forward end of the fuel hub.

Dimensions.—
Max. diameter 8.4 in. (21.3 cm.).
Overall length 21.3 in. (54.1 cm.).
Weight.—
12.7 lb. (5.76 kg.).
Performance.—
Equivalent h.p. 45.

LYCOMING

THE LYCOMING DIVISION OF THE AVCO MANUFACTURING CORPORATION.

Head Office: 550, South Main Street, Stratford, Connecticut.

Works: Stratford, Conn., and Williamsport, Pennsylvania.

President and General Manager: James R. Kerr.

Vice-President, Engineering: Dr. Arthur Nutt.

Vice-President, Turbine Engineering: Dr. Anselm Franz.

Vice-President, Sales: H. Webster Crum.

Vice-President, Manager, Stratford Plant: Donald F. Turner.

Vice-President, Manager, Williamsport Plant: Floyd J. Bird.

Controller: C. J. Mason.

Lycoming is developing two types of small gas-turbine engine for the U.S. Services, under the direction of Dr. Anselm Franz, who was largely responsible for design of the wartime Jumo 004 turbojet in Germany.

Designated T53 and T55, these engines are both of the free-turbine type, in which power can be held constant at varying r.p.m. and *vice versa*. Industrial, automotive and marine versions are also being developed.

Lycoming is also engaged on extensive sub-contract work. During 1958, it produced components for the Allison J71, General Electric J47, J73 and J79, and Pratt & Whitney J57 and J75 turbojets; components for Curtiss-Wright; rotor assemblies for Vertol and Sikorsky helicopters; missile components for McDonnell, Aerojet-General and Douglas; and many other items.

THE LYCOMING LTC1.

Military designation: T53.

The T53 is a shaft-turbine with a free turbine, which is under development under a joint U.S.A.F./U.S. Army contract.

Two versions have been announced as follows:—

T53-L-1 (LTC1B-1). Helicopter configuration. First flight tested in converted Kaman HOK-1. Since fitted in Bell HU-1, Kaman H-43B, Doak Model 16, Ryan Vertiplane, Vertol Models 76 and 105. Normally front-drive, but adaptable to rear drive.

T53-L-3 (LTC1F-1). "Fixed-wing" turboprop configuration. Specified for Grumman OF-1 Mohawk.

Type.—Gas-turbine with five axial and one centrifugal stages of compression, annular combustion chamber and two mechanically-independent turbine stages.

Air Intake.—Annular type casing of magnesium alloy, with 6 struts supporting reduction gearbox and front main bearings. Anti-icing by hot air tapped from engine.

Compressor.—Five axial stages followed by a single centrifugal stage. Two-piece magnesium alloy stator casing with one row of fixed steel inlet guide vanes and five rows of steel stator blades, bolted to one-piece steel alloy diffuser casing with tangential outlet to combustion chamber. Rotor comprises one stainless steel and four aluminium alloy discs with stainless steel blades and one titanium impeller mounted on shaft supported in forward ball thrust and rear roller bearings. Compression ratio 6 : 1. Air mass flow 10.7 lb./sec. (4.85 kg./sec.) at 25,240 gas producer r.p.m.

Combustion Chamber.—Annular reverse-flow type, with one-piece sheet steel outer shell and annular liner. Eleven vaporizing type fuel burners with down-stream injection.

Fuel System.—Chandler-Evans TA-2 fuel control system. Gear-type dual fuel pump with gas producer and power shaft governors, flow control with altitude compensation, shut-off valve and emergency control system.

Fuel Grade.—Mil-F-5624C grade JP-4, or Mil-F-5572.

Turbine.—Two mechanically-independent axial-flow turbine stages. Casing fabricated from sheet steel. First stage, driving compressor, uses hollow air-cooled stator vanes and cored-out cast steel rotor blades and is flange-bolted to shaft. Second stage, driving reduction gearing, has solid steel blades, and is spline-mounted to shaft. Temperature before turbine 1,700°F. maximum at 25,240 gas producer r.p.m.

Exhaust Unit.—Fixed-area nozzle. Steel outer casing and inner cone.

Airscrew Drive (T53-L-3).—No. 51A airscrew shaft. Reduction gear ratio .0802 (12.48 : 1), for airscrew maximum shaft speed of 1,700 r.p.m.

Accessories.—Electric starter or starter-generator, or high-pressure air impingement system. Bendix-Scintilla TGLN high-energy ignition unit. Two igniter plugs.

Lubrication.—Recirculating type, with gear-type pump with one pressure and two scavenge units. Filter.

Oil Grade.—Mil-L-7808C.

Controls.—Hydro-mechanical type, with automatic acceleration and deceleration limiters. Separate fuel and airscrew control.

Dimensions (T53-L-1).—
Length overall 48 in. (1,220 mm.).
Diameter 23 in. (584 mm.).

Dimensions (T53-L-3).—
Length overall 58.9 in. (1,496 mm.).
Diameter 23 in. (584 mm.).
Frontal area 4.15 sq. ft. (0.38 m.²).

Weight (T53-L-1).—
Dry, less tailpipe 480 lb. (218 kg.).

Weight (T53-L-3).—
Dry, less tailpipe 495 lb. (225 kg.

Power Rating (T53-L-1).—
Max. take-off power at S/L 865 e.s.h.p. (825 s.h.p.+100 lb.=45.4 kg. s.t.) at 25,240 gas producer r.p.m.

Power Ratings (T53-L-3).—
Max. take-off power at S/L 1,005 e.s.h.p. (960 s.h.p.+113 lb.=51.3 kg. s.t.) at 25,240 gas producer r.p.m.
Military rating 943 e.s.h.p. (900 s.h.p.+107 lb.=48.5 kg. s.t.) at 24,890 gas producer r.p.m.

Consumptions (T53-L-1).—
Fuel at take-off power 0.673 lb./e.s.h.p./hr. (0.305 kg./e.s.h.p./hr.).

Consumptions (T53-L-3).—
Fuel at take-off power 0.655 lb./e.s.h.p./hr. (0.297 kg./e.s.h.p./hr.).
Fuel at normal power 0.68 lb./e.s.h.p./hr. (0.308 kg./e.s.h.p./hr.).
Oil at normal power 0.14 U.S. gallons/hr. (0.55 litres/hr.).

THE LYCOMING LTC4.

Military designation: T55.

This engine is virtually a scaled-up T53 with higher mass flow and working temperatures. Under development to a joint U.S.A.F./U.S. Army contract, it is intended eventually to be in the 1,800-2,000 s.h.p. range.

Two versions have been announced, as follows.

T55-L-1 (LTC4A-1). "Fixed-wing" version, specified for Fairchild Turboboxcar transport and other projects. Data below refer to this type.

T55-L-3 (LTC4B-1). Helicopter version.

Type.—Gas-turbine, with seven axial and one centrifugal stages of compression, annular combustion chamber and two mechanically-independent turbines.

Air Intake.—Annular type casing of magnesium alloy, with four struts supporting reduction gearbox and front main bearings. Anti-icing by hot air tapped from engine. Intake screens optional.

Compressor.—Seven axial stages followed by a single centrifugal stage. Two-piece magnesium alloy stator casing with one row of fixed steel inlet guide vanes and seven rows of steel stator blades, bolted to steel alloy diffuser casing to which combustion chamber casing is attached. Rotor comprises seven stainless steel discs and one stainless steel impeller mounted on shaft supported in forward ball thrust bearing and rear roller bearing. Compression ratio 6.3 : 1. Air mass flow 19.3 lb. sec./(8.76 kg./sec.) at 18,100 gas producer r.p.m.

Combustion Chamber.—Annular reverse-flow type. Steel outer shell and inner liner. Fourteen vaporizing type fuel burners with downstream injection.

Fuel System.—Hamilton Standard JFC 31 fuel control system. Pesco 023095-010 gear-type fuel pump, with gas producer and power shaft governors, flow control with altitude compensation, shut-off valve and emergency control system.

Fuel Grade.—Mil-F-5624C grade JP-4 or Mil-F-5572.

Turbine.—Two mechanically-independent axial-flow turbines. First turbine, driving compressor, is single-stage type with cored-out cast steel blades and is flange-bolted to shaft. It has hollow stator vanes. Second turbine, driving reduction gearing, is a two-stage type with solid steel blades, and is spline-mounted to shaft.

Exhaust Unit.—Fixed-area nozzle, with inner cone.

Airscrew Drive.—No. 60A airscrew shaft. Reduction gear ratio 0.097 (10.24 : 1), for airscrew maximum shaft speed of 1,320 r.p.m.

Accessories.—Electric starter or starter-generator. Bendix-Scintilla TGLN high-energy ignition unit. Two igniter plugs.

Lubrication.—Recirculating type, with gear-type pump with one pressure and two scavenge units. Filter.

Oil Grade.—Mil-L-7808C.

Dimensions (T55-L-1).—
Diameter 24.25 in. (616 mm.).
Length overall 58.85 in. (1,495 mm.).
Frontal area 4.6 sq. ft. (0.427 m.²).

Dimensions (T55-L-3).—
Diameter 24.25 in. (616 mm.).
Length 44.04 in. (1,118 mm.).

Weight (T55-L-1).—
Dry weight, less tailpipe 695 lb. (315 kg.).

Weight (T55-L-3).—
Dry weight, less tailpipe 600 lb. (272 kg.).

Performance Ratings (T55-L-1).—
Max. take-off power at S/L 1,676 e.s.h.p. (1,600 s.h.p.+190 lb.=86 kg. s.t.) at 18,100 gas producer r.p.m.
Military rating 1,532 e.s.h.p. (1,460 s.h.p.+179 lb.=81.2 kg. s.t.) at 17,810 gas producer r.p.m.

Performance Rating (T55-L-3).—
Max. take-off power at S/L 1,850 s.h.p.+211 lb. (95.7 kg.) s.t. at 18,660 gas producer r.p.m.

Fuel Consumption (T55-L-1).—
Max. take-off power 0.648 lb./h.p./hr. (0.294 kg./h.p./hr.).
Normal power 0.68 lb./h.p./hr. (0.31 kg./h.p./hr.).

Fuel Consumption (T55-L-3).—
Max. take-off power 0.648 lb./h.p./hr. (0.294 kg./h.p./hr.).

MARQUARDT

MARQUARDT AIRCRAFT COMPANY.

Head Office and Works: 16555 Saticoy Street, Van Nuys, California.

President: Roy E. Marquardt.

Executive Vice-President: Robert L. Earle.

Vice-President (Legal and Finance): William H. Schwebel.

Vice-President (Engineering and Van Nuys operations): Don. L. Walter.

Vice-President (Ogden operations): D. K. Tasker.

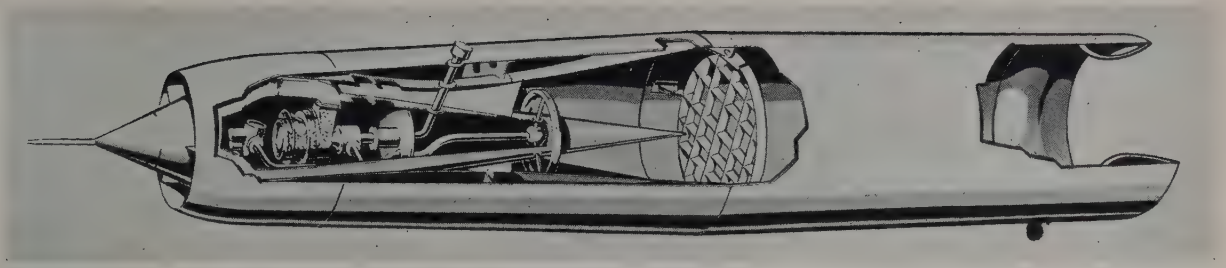
Chief Engineer (Power-plants): John S. Winter.

Chief Engineer (Test Facilities): Leigh E. Dunn.

Chief Engineer (Accessories): A. J. Kreiner.

Director (Air-Space Travel Research Organization): John A. Drake.

The Marquardt Aircraft Company was formed in November, 1944 to undertake



A sectional drawing of the Marquardt MA-20C 28-inch supersonic ramjet.

the research and development of ramjet engines, and at that time it was the only company to be engaged exclusively in this work in the United States.

Much of the work done by Marquardt in the field of supersonic ramjets remains under military security, but it was announced in 1958 that unspecified Marquardt ramjets have flown at Mach 3.95 and at heights above 100,000 ft. (30,500 m.) in Lockheed X-7 test vehicles.

The company also develops and manufactures fuel control equipment and air and hydrogen peroxide turbine-driven accessory power-plants to meet the hydraulic, electrical and fuel-pump requirements of ramjet and rocket-powered missiles and turbojet-powered aircraft.

The Marquardt Jet Laboratory is one of the most powerful facilities in the United States for the testing of ramjet engines and related equipment and accessories. It is capable of testing full-scale flight ramjet engines and can simulate speeds approaching 2,000 m.p.h. (3,200 km.h.) and altitudes above 80,000 ft. (24,400 m.).

Marquardt is also developing and manufacturing variable-area turbojet exhaust nozzles of advanced design for nearly all of the major engine companies in the United States and Canada.

One completely new type of multi-purpose variable-area exhaust nozzle incorporates a reverse-thrust feature. Another feature of the nozzle is its ability to trim in flight to an area which will achieve the minimum specific fuel consumption for the turbojet engine for a given cruise thrust requirement. This feature alone will more than pay for the added weight of the nozzle (less than 100 pounds) in fuel saved and increased range and endurance.

Marquardt has attained major stature as the developer and producer of ram air emergency power-units which supply electrical and hydraulic power to turbojet piloted aircraft if the main power-plant fails. These units are now in operation on the Chance Vought F8U-1, the Convair F-102 and the Lockheed F-104.

As a result of the success of its supersonic ramjet development programme, Marquardt has built a manufacturing plant and production acceptance testing facility at Ogden, Utah. This plant is engaged mainly on production of RJ43 ramjet engines to power the Boeing Bomarc surface-to-air interceptor missile.

In 1956 Marquardt contracted with the U.S. Air Force to develop through to preliminary flight rating a 36 in. ramjet which carries the company designation MA-24, and which has higher performance capabilities than the RJ43. No details of the MA-24 may yet be published.

THE MARQUARDT RJ59.

No details of this supersonic ramjet are yet available, except that it has been flight tested successfully in the Lockheed X-7A-2 test vehicle.

THE MARQUARDT RJ57.

First mentioned in Marquardt's 1958 Annual Report, the RJ57 is a new supersonic ramjet of which no details are yet available.

THE MARQUARDT MA-20C.

Military designation: RJ43.

Few details of this comparatively large ramjet engine are available for publication, beyond those which can be gained from the accompanying cutaway drawing. It is intended for use at supersonic speeds.

The RJ43 (company designation MA-20C) has a fixed-geometry air intake, a centre-body which houses the fuel system and controls, and a convergent/divergent nozzle. The kerosene fuel is fed by a ram-air turbine pump.

Reference can be made to the following versions :—

RJ43-MA-1. Initial version tested in the Lockheed X-7A-1 test vehicle.

RJ43-MA-3. In production for Boeing IM-99A Bomarc missile.

RJ43-MA-5. Developed for Lockheed Q-5 target drone.

RJ43-MA-7. Under development for the improved XIM-99B Bomarc missile. Tested initially in the Lockheed X-7A-3 test vehicle.

Dimensions (RJ43-MA-3).—
Diameter 28 in. (710 mm.).
Length approx. 145 in. (3,685 mm.).
Weight Dry (RJ43-MA-3).—
485 lb. (220 kg.).
Performance Rating (RJ43-MA-3).—
Max. thrust at S/L approx. 11,500 lb. (5,220 kg.).

THE MARQUARDT MA-19G.

U.S. Navy designation : RJ30-MA-6.

Type.—Subsonic Ramjet.
Maximum Exhaust Temperature.—Over 3,000°F.
Dimensions.—
Max. length 87.25 in. (221.6 cm.).
Diameter 20.0 in. (50.8 cm.).
Weight Dry.—
126 lb. (57.2 kg.).
Performance Ratings.—
Max. net thrust 1,450 lb. (660 kg.).
Rated net thrust 1,200 lb. (545 kg.).

PRATT & WHITNEY

THE PRATT & WHITNEY AIRCRAFT DIVISION OF UNITED AIRCRAFT CORPORATION.

Head Office and Works: East Hartford 8, Connecticut.

Vice-President: Wright A. Parkins.

General Manager (Connecticut): L. C. Mallet.

General Manager (Florida): C. T. Roelke.

Engineering Manager: Perry W. Pratt.

Assistant Engineering Manager: B. A. Schmickrath.

Sales Manager: B. J. McNamara.

Factory Manager: John L. Bunce.

Pratt & Whitney Aircraft entered the gas-turbine engine field in 1947 by acquiring the American manufacturing and sales rights for the Rolls-Royce Nene engine. These rights were later expanded to include the Rolls-Royce Tay, a development of the Nene. Both these engines were developed to meet U.S. Navy requirements and to incorporate materials, parts and accessories from United States sources. As the J42 and J48, respectively, they have been produced in quantity to power mainly the Grumman F9F-2 and F9F-5 Panther, the Grumman F9F-6 and F9F-8 Cougar and the Lockheed F-94C Starfire. The J48 is still in production.

Pratt & Whitney Aircraft has been in production with the J57 dual-compressor axial-flow turbojet, the first American engine to be rated in the 10,000-lb. thrust class, since February, 1953. The T34 turboprop engine is also in production.

The existence of the J75 axial-flow turbojet was revealed in 1954. Although still classified, the J75 in a civil form (JT4) is specified for installation in versions of the Boeing 707 and Douglas DC-8 civil jet airliners, as is the JT3, a civil version of the J57.

Both the JT3 and JT4 were certified by the C.A.A. for airline use on March 15, 1957, being the first American-built turbojets to receive such certification, except for an early model of the JT3 which was certified on August 23, 1954, for use in the Boeing 707 prototype.

A medium-size turbojet, designated J52, was announced in December, 1956, but few details have been released. Also under development are the very large J58, for use in Mach 3 military aircraft, and the JT-12 lightweight turbojet, of which brief details were released in 1958.

In January, 1958, Pratt & Whitney occupied more than seven million square feet of floor area in twelve Connecticut towns, and employed 38,000 people. More than 80% of its current production consists of gas-turbine engines.

The company's nuclear engine programme is carried on as a separate operation at a U.S.A.F.-sponsored facility in Middletown, Connecticut. Begun in 1951, this project is now covered by the code-name of CANEL (Connecticut Aeronautic Nuclear Engine Laboratory).

Third Pratt & Whitney operational unit will consist of a development and test centre that is being built at West Palm Beach, Florida.

THE PRATT & WHITNEY JT-12.

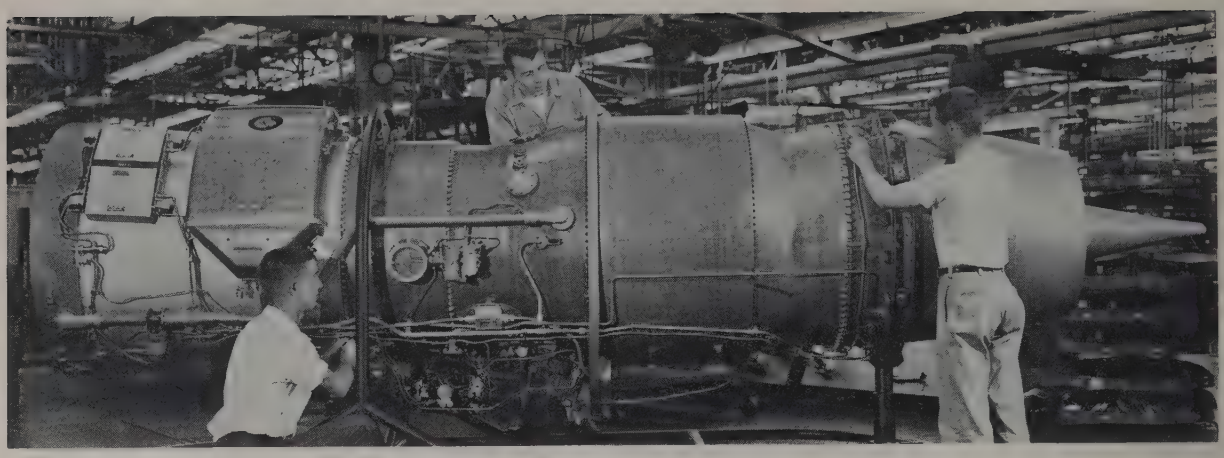
The JT-12 is a small high-performance turbojet engine, designed specifically for economical production. It has an initial rating of 2,900 lb. (1,315 kg.) s.t. and weighs only 430 lb. (195 kg.). No construction details are available except that it is a single-spool engine.

Design of the JT-12 was started in July, 1957 and the prototype ran for the first time in May, 1958. By September, 1958, it had completed a 15-hr. rating test for missile applications, and was being studied for use also in military and commercial aircraft.

THE PRATT & WHITNEY J75.

Civil designation: JT4.

First announced in 1954, few details of this twin-compressor axial-flow turbojet engine have been released. It is more powerful than the J57 and powers the Convair F-106 interceptor, the production Martin P6M-2 SeaMaster flying boat,



The Fratt & Whitney J75 turbojet engine (17,200 lb.=7,800 kg. s.t.).

Republic F-105 Thunderchief fighter and Chance Vought F8U-3 naval interceptor. Production of the J75 began in the Spring of 1957, after more than two years of flight testing in research and experimental aircraft.

The commercial version of the J75, known as the JT4, received C.A.A. certification for airline use in March, 1957 and will power versions of the Boeing 707 and Douglas DC-8 jet airliners.

DIMENSIONS.—
Diameter 43.0 in. (1,092 mm.).
Length (JT4A-3) 189.2 in. (4,806 mm.).
Length (J75-P-5) 259.3 in. (6,586 mm.).
Length (J75-P-9) 237.6 in. (6,035 mm.).

WEIGHTS.—
JT4A-3 5,020 lb. (2,277 kg.).
J75-P-5 5,950 lb. (2,700 kg.).
J75-P-9 5,875 lb. (2,665 kg.).

PERFORMANCE (J75).—
Max. T.O. thrust 17,200 lb. (7,800 kg.).
Max. T.O. thrust with afterburner approx. 24,500 lb. (11,115 kg.).

PERFORMANCE (JT4A).—
Max. T.O. thrust 15,500-16,800 lb. (7,030-7,620 kg.).

THE PRATT & WHITNEY J58.

Intended for operation at high altitudes and high Mach numbers, the J58 is a very large single-spool turbojet engine in the 30,000 lb. (13,600 kg.) s.t. class. No details are available except that it completed a 50-hr. test in the Summer of 1958, only six months after the first experimental engine was constructed.

THE PRATT & WHITNEY J57.
Civil designation: JT3.

The J57 is a large axial-flow turbojet engine which is in production for the U.S.A.F. and powers many of America's current first-line fighter and bomber aircraft.

The J57 has a two-spool layout, with seven-stage high-pressure and nine-stage low-pressure compressors mounted in tandem on concentric shafts. The low-pressure compressor and a two-stage low-pressure turbine are on the inner shaft, while the high-pressure compressor and a single-stage high pressure turbine are on the outer shaft. The turbine blades are shrouded to provide end support, making them less susceptible to vibration, and to reduce gas flow around the tips.

Between the compressor and turbine is the combustion chamber which, in the J57, is of the "cannular" type, comprising an outer annular casing which encloses eight "cans" or flame-tubes, each with six fuel nozzles. A feature of each flame-tube is that combustion and cooling air is introduced through a central tube as well as through the outer walls to improve combustion efficiency. Air mass flow is 181 lb./sec. (82 kg./sec.) and compression ratio 12.5 : 1.

Basic design of the J57 began in 1947 and the final design was adopted in 1949 after extensive component testing. The prototype ran for the first time in January, 1950 and a J57 became airborne for the first time in March, 1951 in a B-50 flying test bed, soon after passing its 50-hour preliminary flight rating test.

The J57 began its 150-hour qualification tests on September 8, 1952, and the engine went into production in February, 1953. By March, 1957 more than 8,000 J57's had been delivered.

The J57 powers the Boeing B-52 eight-jet bomber, the Boeing KC-135 four-jet tanker-transport, the North American F-100, Convair F-102 and McDonnell F-101 fighters, the Douglas F4D-1 and Chance Vought F8U-1 and F8U-2 naval fighters, the Douglas A3D naval attack bomber and the Northrop SM-62 Snark long-range missile. The engines used in the F-100, F-101, F-102, F4D, F8U-1 and F8U-2 are fitted with afterburners.

The J57 in its civil form (JT-3C-6) has been selected to power versions of the Boeing 707 and Douglas DC-8 jet airliners and was certified by the C.A.A. for airline use in March, 1957.

DIMENSIONS (J57-P-19W).—
Diameter 40.5 in. (1,029 mm.).
Length 157.52 in. (4,000 mm.).

DIMENSIONS (J57-P-31W).—
Diameter 38.88 in. (987 mm.).
Length 167.33 in. (4,250 mm.).

WEIGHTS.—
J57-P-19W 3,970 lb. (1,800 kg.).
J57-P-31W 3,820 lb. (1,733 kg.).

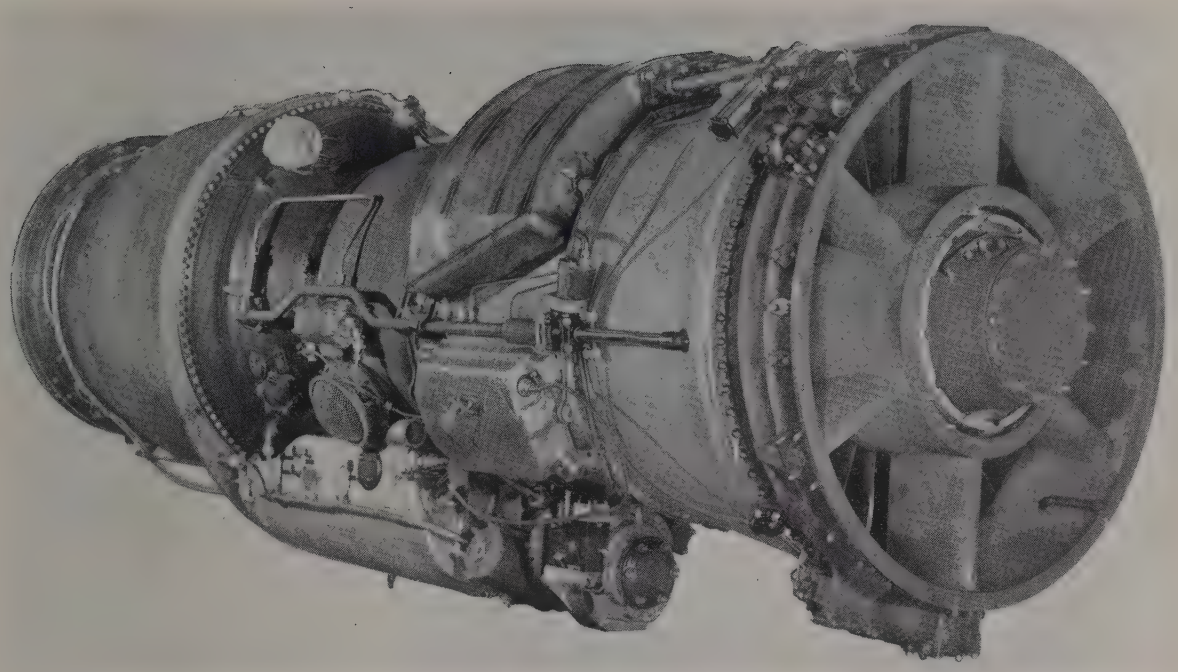
PERFORMANCE RATING (J57-P-19W).—
Max. T.O. power with water injection 12,100 lb. (5,488 kg.) s.t.

PERFORMANCE RATING (JT-3C-6).—
Max. T.O. power 13,000 lb. (5,900 kg.) s.t.

FUEL CONSUMPTION (JT-3C-6).—
Cruising power 0.92 lb./lb. st./hr. (0.92 kg./kg. s.t./hr.).



The Pratt & Whitney J75 (*left*) and J57 turbojet engines, both fitted with afterburners.



The Pratt & Whitney J57 axial-flow turbojet engine which powers many current U.S. fighters and bombers.

THE PRATT & WHITNEY JT-3D.

For two or three years Pratt & Whitney have been experimenting with the use of turbo-fans to improve the efficiency of their basic turbojet designs. Now under active development is the JT-3D turbo-fan engine, which is based on the JT-3C turbojet.

No official details have yet been given, but the JT-3D is reported to have a two-stage fan at the front, replacing the first three stages of the low-pressure compressor to which it is attached. Of considerably-larger diameter than the compressor, this fan extends well outside the compressor casing and is contained in a short-chord annular shroud. An additional low-pressure turbine stage is reported to have been added at the rear to provide the extra shaft power needed to drive the fan.

The JT-3D is claimed to provide 30% more power than the JT-3C, and to offer a 10-15% reduction in cruising specific fuel consumption, plus a reduction in peak noise level of 10 decibels. Production models are expected to be available in 1961.

THE PRATT & WHITNEY J52.

Announced in December, 1956, the J52 turbojet is a medium-sized engine which was designed under the auspices of the U.S. Navy Bureau of Aeronautics to meet the power plant requirements of a variety of new naval aircraft, including the Grumman A2F carrier-based attack bomber.

Few details of the J52 are available for publication. It is reported to be a two-spool turbojet, with a "cannular" type combustion system fed by nine dual-orifice injectors, mechanically-independent high-pressure and low-pressure turbines and provision for an afterburner with multiple injectors and a variable-area nozzle. The J52-P-4 version is rated at 7,250 lb. (3,288 kg.) s.t. dry, with a specific fuel consumption of 0.8 lb./lb. s.t./hr. (0.8 kg./kg. s.t./hr.).

THE PRATT & WHITNEY J48

The J48 is the result of pooling of the engineering talents of two of the World's leading engine builders—Pratt & Whitney Aircraft and Rolls-Royce, Ltd. The basic design is Rolls-Royce, the British version of the J48 being known as the Tay.

The J48 is a development of the J42 which is the Pratt & Whitney-built Nene. A re-designed impeller and larger turbine blades enable the J48 to consume 30 per cent. more air and, in turn, to produce more thrust. The J48 is, however, essentially interchangeable with the J42 because dimensional differences are slight. One of Pratt & Whitney's main independent contributions to the J48 is the afterburner.

Dimensions.—
Diameter 50.5 in. (1,283 mm.).
Length (without fixed nozzle) 109.75 in. (2,788 mm.).

Weight Dry.—
2,080 lb. (944 kg.).

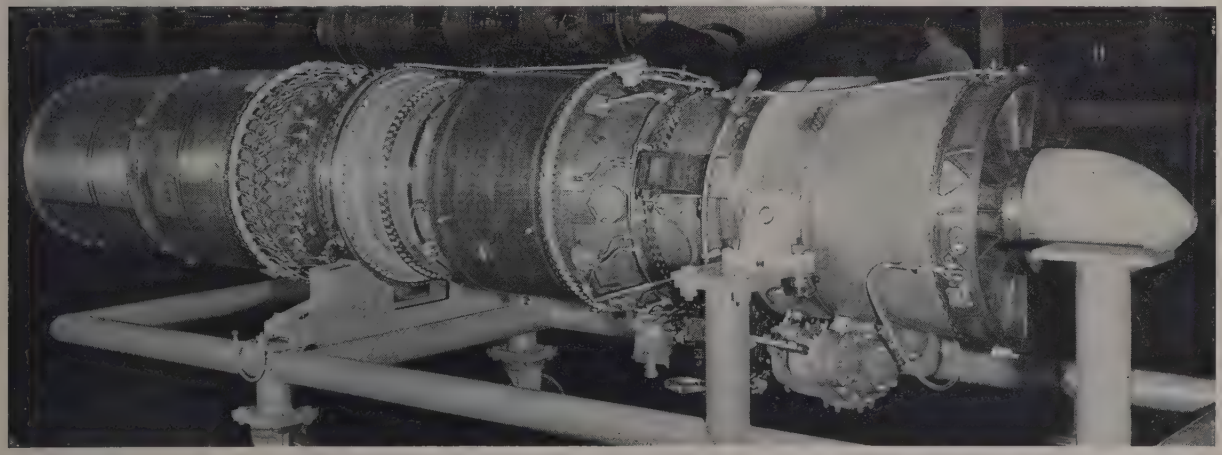
Performance Ratings.—
Take-off (and Military) rating 7,250 lb. (3,290 kg.) s.t.
Normal rating 5,600 lb. (2,540 kg.) s.t.
Cruise rating 3,750 lb. (1,700 kg.) s.t.

Fuel Consumptions.—
At take-off output 1.14 lb./lb. s.t./hr. (1.14 kg./kg. s.t./hr.).
At normal output 1.12 lb./lb. s.t./hr. (1.12 kg./kg. s.t./hr.).
At cruise output 1.14 lb./lb. s.t./hr. (1.14 kg./kg. s.t./hr.).

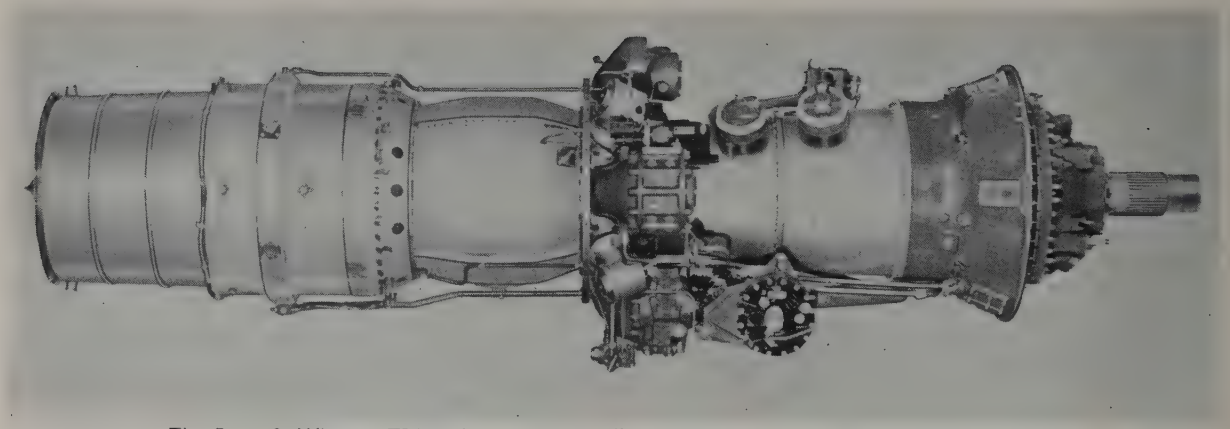
THE PRATT & WHITNEY T34

The T34 is a single-unit high-pressure axial-flow turboprop engine, the active development of which was begun in June, 1945 under the auspices of the U.S. Navy Bureau of Aeronautics as part of the Navy's overall programme to develop this type of power-plant. A T34 engine completed a 50-hour flight rating test at 5,700 h.p. and flight testing in the nose of a Boeing B-17 began in August, 1950.

The T34 has a 13-stage axial-flow compressor with an annular type burner and a three-stage axial-flow turbine.



The Pratt & Whitney J52 turbojet engine (7,250 lb.=3,288 kg. s.t.).



The Pratt & Whitney T34 turboprop engine (5,500 s.h.p. plus 1,250 lb.=567.5 kg. jet thrust).

Stainless steel is used almost exclusively in the construction of the T34.

The airscrew reduction gear is flexibly coupled to the front of the compressor shaft and the compressor and turbine are rigidly coupled at the rear of the compressor case. The reduction gear uses two stages and operates at an 11 : 1 ratio.

The engine incorporates a mechanical control system in which a single lever is linked to mechanical controls that automatically control the fuel flow and coordinate it with airscrew speed, flight speed and altitude for the particular power selected by the pilot.

De-icing is accomplished by hot air bled from the engine to the air inlet area.

The following versions of the T34 have been announced :—

YT34-P-1. Basic prototype engine, burning gasoline fuel. Flight tested in Douglas YC-124B aircraft. Rated at 5,550 e.s.h.p. (5,005 s.h.p.). S.F.C. of 0.64. Weight 2,550 lb. (1,157 kg.).

YT34-P-12A. Same as YT34-P-1 except in minor details. Burned JP-4 fuel. Fitted to Lockheed R7V-2 aircraft. Rated at 5,550 e.s.h.p. (5,005 s.h.p.) S.F.C. of 0.66. Weight 2,576 lb. (1,168 kg.).

T34-P-3. Basic production version. No major assemblies except fuel pump and compressor rotor assembly interchangeable with prototypes. Powers Douglas C-133A.

T34-P-3A. Same as T34-P-3, but without C.S.D. unit. Increased reverse-thrust. Powers Douglas C-133A.

YT34-P-5. Same as T34-P-3 except in minor details. Flown in Boeing YC-97J.

T34-P-6. Same as T34-P-3 except in minor details. Fitted to Lockheed C-121F.

T34-P-7W. Same as T34-P-3A except has wide-chord turbine giving better altitude performance, and coolant injection to maintain standard day T.O. rating up to 100°F. ambient temperature. Powers Douglas C-133A.

T34-P-7WA. Same as T34-P-7W, except has increased capacity thrust bearing. Powers Douglas C-133A.

T34-P-9W. Same as T34-P-7W, but with improved turbine, increased tail-pipe nozzle area and revised fuel flow providing increased turbine inlet temperature. Rated at 6,500 e.s.h.p. (5,950 s.h.p.). S.F.C. of 0.60. Powers Douglas C-133B.

DIMENSIONS.—
- Max. diameter 33.75 in. (857 mm.).
- Length (T34-P-3, 5, 6, 7 series) 156.8 in. (3,983 mm.).
- Length (T34-P-9W) 154.1 in. (3,914 mm.).

WEIGHT DRY.—
- T34-P-3, 5, 6 series 2,590 lb. (1,175 kg.).
- T34-P-7 series 2,670 lb. (1,211 kg.).
- T34-P-9W 2,870 lb. (1,302 kg.).

PERFORMANCE RATINGS (T34-P-3, 5, 6, 7 series).—
- Take-off output 5,500 s.h.p. plus 1,250 lb. (567.5 kg.) jet thrust (6,000 equivalent s.h.p.).
- Military rated output 5,300 s.h.p. plus 1,250 lb. (567.5 kg.) jet thrust (5,800 equivalent s.h.p.).
- Normal rated output 4,750 s.h.p. plus 1,125 lb. (511 kg.) jet thrust (5,200 equivalent s.h.p.).
- Cruising output (80% normal rating) 3,800 s.h.p. plus 1,000 lb. (454 kg.) jet thrust (4,200 equivalent s.h.p.).
- Cruising output (60% normal rating) 2,850 s.h.p. plus 875 lb. (427 kg.) jet thrust (3,200 equivalent s.h.p.).

FUEL CONSUMPTION (T34-P-3, 5, 6, 7 series).—
- At take-off power 0.630 lb. (0.286 kg.) per equiv. s.h.p./hr.
- At military power 0.635 lb. (0.288 kg.) per equiv. s.h.p./hr.
- At normal power 0.655 lb. (0.297 kg.) per equiv. s.h.p./hr.
- At cruise (80% power) 0.70 lb. (0.318 kg). per equiv. s.h.p./hr.

RMI

REACTION MOTORS DIVISION OF THIOKOL CHEMICAL CORPORATION.

HEAD OFFICE, WORKS AND LABORATORY : DENVILLE, NEW JERSEY.

FIELD OFFICES : LOS ANGELES, CALIFORNIA ; DAYTON, OHIO ; AND WASHINGTON, D.C.

President : Raymond W. Young.

Vice-President, Program Director of X-15 Project and Executive Assistant to the President : Joseph W. Antonides.

Vice-President, Production : Fred D. Pfotenhauer.

Vice-President, Marketing : David C. Eaton.

Secretary and General Counsel : Alexander L. Keyes.

Assistant Treasurer and Director of Finance Division : Robert M. Lawrence.

Director of Administration Division : A. Robert Taylor.

Director of Research Division : E. H. Seymour.

Chief Engineer : D. F. Ferris.

Director of Production Division : E. B. Parke.

Reaction Motors designed and built the first rocket-type power-unit for aircraft use to be developed in the United States. This engine, which carried the designation 6000C4, was used in the Bell X-1, which was the first aircraft to exceed the speed of sound.

Re-design and improvement of the 6000 Series engine was completed during 1955, resulting in a new engine designation, with higher thrust and performance ratings.

The ROR (Rocket-on-Rotor) system, announced in 1954, has been tested by a U.S. Marine Corps helicopter squadron and the operational flight evaluation programme has been completed successfully. Reaction Motors have also developed small 16 lb. (7.25 kg.) s.t. peroxide rotor-tip rockets to power the Kellett KH-15 and Rotorcraft RH-1 single-seat helicopters.

Several engineering programmes devoted to the design of advanced rocket engine systems and components and to the improvement of rocket engine ignition and combustion characteristics are in hand, while various ways of improving the characteristics of present liquid rocket propellents are under investigation and new propellents are being studied and evaluated. The major work currently in hand includes a contract to develop the rocket-engine for the North American X-15 manned hypersonic research aircraft and power plants for several important missile systems.

It has been announced that Reaction Motors have fired a rocket motor of 120,000 lb. (54,430 kg.) s.t. and have made nearly 100 test runs of 50,000 lb. (22,680 kg.) s.t. motors.

In the Spring of 1958, Reaction Motors merged with Thiokol Chemical Corp. of Trenton, New Jersey. The new combined company offers an organisation capable of advanced research, development and production in liquid and solid propellent rocket engines.

THE RMI PIONEER.
Military designation: XLR99-RM-2.

The Pioneer is a liquid-propellent rocket engine which will power the North American X-15 hypersonic research aircraft. No details have been released officially, but it is reported to have a designed output of 60,000 lb. (27,215 kg.) s.t. at sea level and to employ anhydrous ammonia and liquid oxygen as its propellents. The propellents are turbo-pump fed to a single chamber.

THE RMI GUARDIAN.
Military designation: LR44-RM-2.

In production for the U.S. Navy, the Guardian is the first of a new family of packaged liquid-propellent engines. It is an integral unit, comprising motor, propellent tankage and all components necessary for operation, which is supplied in fully-loaded condition, complete with propellents. Special design features enable it to be stored in this condition for extended periods, so overcoming a major disadvantage of liquid-propellent units. No further details are available.

THE RMI PATRIOT.

No details are available of this liquid-propellent rocket engine, which has been developed for the Temco Corvus air-to-surface missile.

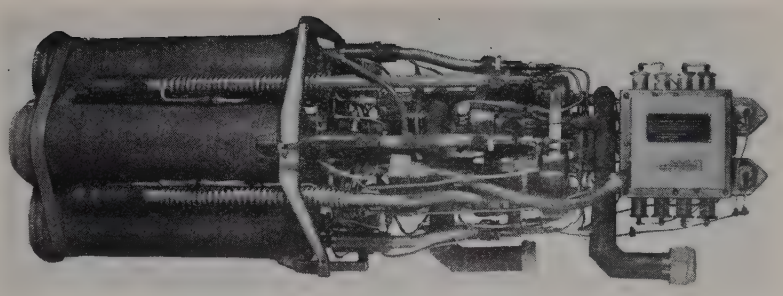
THE R.M.I. MODEL TU205.

The TU205 is one of a family of small liquid-propellent rocket engines which has been developed for all current and anticipated drone propulsion requirements.

TYPE.—Liquid bi-propellent Rocket.
CONSTRUCTION.—Dual chamber, Double-wall construction, with one of the propellents circulated as coolant.
PERFORMANCE.—
Max. rating 200 lb. (91 kg.) s.t.
Sustainer chamber rating 60 lb. (27 kg.) s.t.
Booster chamber rating 140 lb. (64 kg.) s.t.

THE RMI 6000 SERIES.
Military designation: LR8-RM-6.

TYPE.—Liquid bi-propellent Rocket.
CONSTRUCTION.—Chrome-molybdenum steel girder frame supports the combustion chambers, fuel supply and control system, and includes centrally-disposed transverse frame for attachment to airframe. Stainless steel tubular combustion chambers have closed front ends and venturi-type expansion nozzles.
PROPELLENTS.—Ethyl alcohol-water mix (fuel) and liquid oxygen (oxidiser) are injected into front end of combustion chambers under pressure supplied by helium gas or pressurised nitrogen and ignited. Four control valves each in fuel and oxidiser lines to ensure uniform pressure at entry to chambers.
IGNITION.—Separate igniter in each chamber. Igniter uses fuel/oxydiser mixture which is fired by B.G. igniter plus an Eclipse coil. Electrically operated from control box on front of engine. Chambers can be fired individually, in any combination or all together.
COOLING.—Regenerative. Fuel before injection is circulated through coolant passages in exhaust nozzles and around combustion chambers.
MOUNTING.—Four circumferentially-located mounting points on main frame.
DIMENSIONS.—
Diameter 19.0 in. (482.6 mm.).
Length 56.0 in. (1,422.4 mm.).
Frontal area 2.0 sq. ft. (0.186 m.²).
WEIGHTS.—
Weight dry 210 lb. (95.34 kg.).
Weight/thrust ratio 0.035 lb./lb. thrust (0.035 kg./kg. thrust).
PERFORMANCE.—
Max. rating 6,000 lb. (2,725 kg.) thrust at any altitude.
Jet velocity 6,182 ft. (1,885.5 m.) per sec.
Specific impulse 192/sec.
Propellent consumption 0.0052 lb./lb. thrust/sec.



The RMI Model 6000C4 liquid-propellent rocket motor.

ROCKETDYNE

ROCKETDYNE DIVISION OF NORTH AMERICAN AVIATION, INC.

OFFICES AND WORKS: CANOGA PARK, CALIFORNIA.
PROPULSION FIELD LABORATORY: SANTA SUSANA MOUNTAINS, VENTURA COUNTY, CALIFORNIA.

Rocketdyne is a division of North American Aviation, devoted primarily to the design and manufacture of large rocket engines for the U.S. Air Force, Army and Navy. It was established as a separate division on November 8, 1955.

North American's interest in missile development dates back to 1947, when the company began work on the 14 ft. (4.25 m.) NATIV research rocket. In 1950, the company built and tested the first high-thrust liquid-propellent engine larger than that of the wartime German V-2 rocket. To-day it is the leading manufacturer of large liquid-propellent rockets in the United States and is producing engines in quantity for the Army's Redstone and Jupiter missiles and the U.S.A.F.'s Atlas ICBM and Thor IRBM. A modified Redstone engine, burning special fuel, was used to launch America's Explorer Earth satellites.

Contracts awarded to Rocketdyne in the Summer of 1958 include U.S.A.F. contracts for the development of a single-chamber 1,000,000 lb. (450,000 kg.) s.t. engine and for a propulsion system developing thrust mid-way between this output and the thrust of current production engines. A U.S. Army contract covers construction of a booster vehicle comprising a cluster of existing Thor and Jupiter type engines, to give a total thrust of 1,500,000 lb. (680,000 kg.).

SOLAR

SOLAR AIRCRAFT COMPANY.

HEAD OFFICE AND WORKS: 2200, PACIFIC HIGHWAY, SAN DIEGO 12, CALIFORNIA.
MIDWEST WORKS: DES MOINES 5, IOWA.
President: Herbert Kunzel.

The Solar Aircraft Company specialises in the design, development and manufacture of heat-resistant alloy products, which broad term includes such items as small auxiliary gas-turbine power-units, afterburners, control systems of turbojet and ramjet engines, etc. It has evolved several patented processes for the manufacture of high temperature-resistant materials, for the protection of alloy steels against oxidation and corrosion, and for the aluminium coating of high-temperature parts.

Solar also handles considerable subcontract work in the aircraft, engine and missile fields.

Solar's Mars and Jupiter gas turbines are being produced in quantity. The Mars, rated at 50-60 s.h.p., provides auxiliary power for accessories in the Douglas C-124C, Lockheed C-121C, Boeing KC-97 and Convair C-131B, while the Jupiter, rated at 500 s.h.p., is used as a compressor in multi-purpose turbojet support vehicles, and as a variable-speed power-unit for marine propulsion.

Solar is designing and will produce, under a joint Navy Bureau of Aeronautics and U.S. Army contract, the smallest gas-turbine engine for aircraft propulsion. This engine, known as the YT62 Titan, will be used to power a one-man helicopter. A variable-speed version, designated YT66, is also being developed.



The Solar YT62 Titan.

THE SOLAR TITAN.
Military designation: YT62.

The Titan is a small shaft-turbine with a centrifugal compressor, an annular combustion chamber and a single-stage turbine. Starting will be by geared hand-crank and the engine will operate on standard military fuels. As the engine is still under security classification no further details are available for publication.

The general arrangement of the Titan can be gathered from the accompanying illustration, which shows a mock-up of the engine.

DIMENSIONS.—
Max. overall diameter 15½ in. (394 mm.).
Overall height (as shown) 20 in. (508 mm.).
WEIGHT DRY.—
50 lb. (22.7 kg.).
RATING.—
Max. 55 s.h.p. plus 12 lb. (5.45 kg.) residual thrust at 57,600 r.p.m.

THE SOLAR YT66.

The YT66 will be a variable-speed gas-turbine, developed from the constant-speed YT62 Titan. It will power "flying platform" aircraft under evaluation by the U.S. Army.

Dimensions, weight and performance are as for the YT62.

WESTINGHOUSE

WESTINGHOUSE ELECTRIC CORPORATION, AVIATION GAS TURBINE DIVISION.

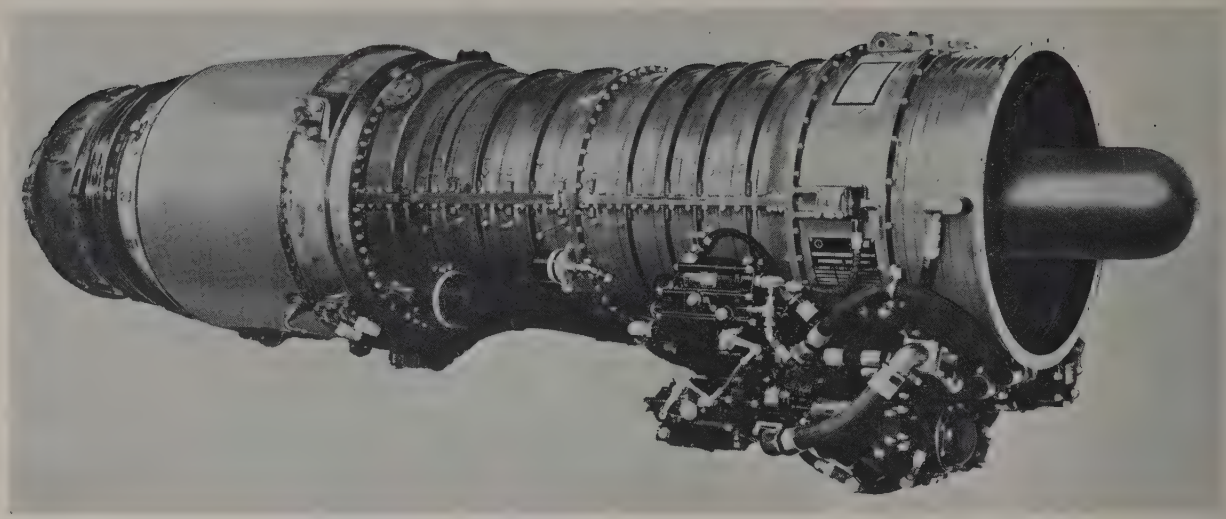
HEAD OFFICE AND WORKS: KANSAS CITY, MISSOURI.
Division Manager: W. W. Smith.
Chief Engineer: A. Chilton.
General Manager, Sales and Service: J. D. Redding.

The Westinghouse Electric Corporation began the development of aviation gas turbines in December, 1941, at the request of the U.S. Navy Bureau of Aeronautics.

The first Westinghouse jet engine, designated X19A, was the first turbojet engine in the United States to be developed exclusively from American design efforts. It was completed in March, 1943.

Among the several models since produced by Westinghouse are the J30, J34, J40, J46 and J54.

In 1953, an eight-year agreement was signed between Westinghouse and Rolls-Royce, Ltd., of Derby, England, under which the two companies have exchanged information on the design, development and production of turbojet engines. In addition, Westinghouse have sales and manufacturing rights in America for Rolls-Royce engines other than those imported into the United States in complete aircraft.



The Westinghouse J34-WE-46 turbojet engine (3,400 lb.=1,542 kg. s.t.).

THE WESTINGHOUSE J34-WE-46.

The J34 turbojet was put back in production in 1956, nearly ten years after the first engines of this type were delivered. The current J34-WE-46 version powers the new North American T2J basic trainer.

This latest version incorporates a new compressor, a new combustion chamber and other modifications to permit the use of both JP4 and JP5 turbofuels. It was given official approval for service in U.S. Naval aircraft early in 1958 after two engines had each completed a 150-hour qualification test, one engine running on JP4 and the other on JP5.

Westinghouse received a $26 million contract from the U.S. Navy in November, 1957, for production of the J34-WE-46, and was awarded a further $5,600,000 contract in April, 1958, for further development of the J34.

TYPE.—Axial-flow Turbojet.

COMPRESSOR.—Eleven-stage axial-flow. Compressor casing of aluminium alloy. Compression ratio 4.35 : 1.

COMBUSTION CHAMBER.—Annular type, with stainless steel outer casing and stainless steel concentrically-mounted double perforated liner. Fuel spray nozzles on outer and inner annulars. Fuel injected downstream.

FUEL SYSTEM.—Fuel supplied to manifold in two concentric fuel rings at forward end of combustion chamber. Flyweight type all-speed fuel control.

FUEL GRADE.—JP4 or JP5.

NOZZLE GUIDE VANES.—Stationary vanes in turbine section are of cast vitalium.

TURBINE.—Two-stage axial-flow. Discs of nickel steel alloy with stellite blades.

JET PIPE.—Stainless steel fixed inner cone and outer casing.

LUBRICATION SYSTEM.—Dry sump type. Nichols gear-type pump with one pressure and five scavenge units.

ACCESSORIES DRIVE.—Gearbox mounted at vertical centre-line below engine.

DIMENSIONS.—
Diameter 27 in. (686 mm.).
Height 34.7 in. (881 mm.).
Length 111.4 in. (2,830 mm.).

WEIGHT DRY.—
1,207 lb. (548 kg.).

PERFORMANCE RATING.
3,400 lb. (1,542 kg.) at 12,500 r.p.m. at 45,000 ft. (13,700 m.).

THE WESTINGHOUSE XJ81-WE-3.

The XJ81 is a small lightweight axial-flow turbojet engine, basically similar to the Rolls-Royce Soar, which is intended primarily for drones and missiles. All further details are classified.

WRIGHT

WRIGHT AERONAUTICAL DIVISION, CURTISS-WRIGHT CORPORATION.

HEAD OFFICE AND WORKS: WOOD-RIDGE, N.J.

RESEARCH AND DEVELOPMENT CENTER: QUEHANNA, PENNA.

Chairman of the Board and President: Roy T. Hurley.

Vice-President and General Manager: J. V. Miccio.

Director of Engineering: Joseph P. Grandfield.

The Wright Aeronautical Division of Curtiss-Wright holds licences for the manufacture of the Armstrong Siddeley Sapphire (J65) and the Bristol Olympus and Orpheus engines.

Production of the J65 engine was begun in 1951. This engine, fitted in some cases with an afterburner manufactured by the Solar Aircraft Company, is installed in the Republic F-84F and RF-84F, the Martin B-57, the North American FJ-3 and FJ-4, the Grumman F11F-1, the Douglas A4D-1 and the Chance Vought Regulus II flight test missile.

Wright had two turboprop engines under development, the T49, a single-shaft turboprop development of the J65, and its commercial counterpart, the TP51A2, but these have now been abandoned.

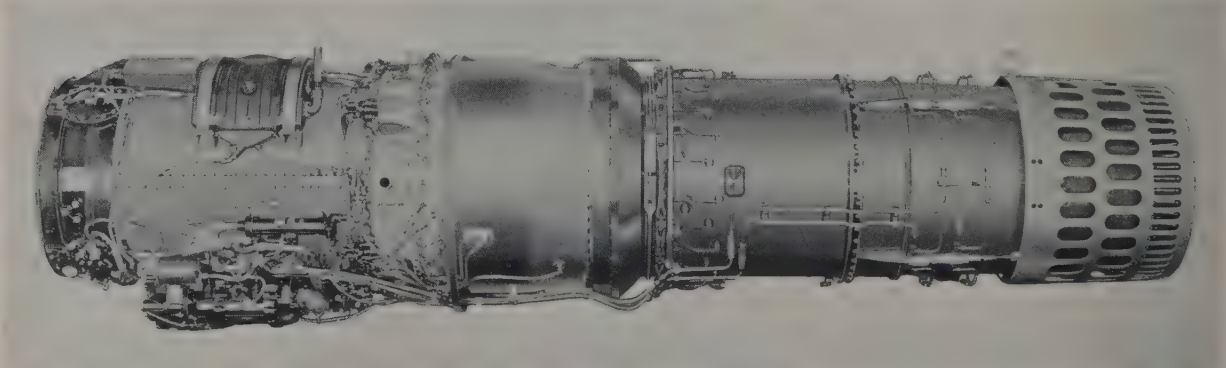
The company is engaged on the development of ramjets for guided missile applications, in connection with which it opened the largest privately-owned, high-altitude, supersonic research laboratory in the world at Wood-Ridge in July, 1955.

During 1956, Curtiss-Wright purchased from Studebaker-Packard Corporation the Aerophysics Development Corporation of Santa Barbara, Cal., which is now operated as a wholly-owned subsidiary. Aerophysics products include the highly-successful Hypersonic Test Vehicle and Dart anti-tank missile, which are described in the "Guided Missiles" section of this annual.

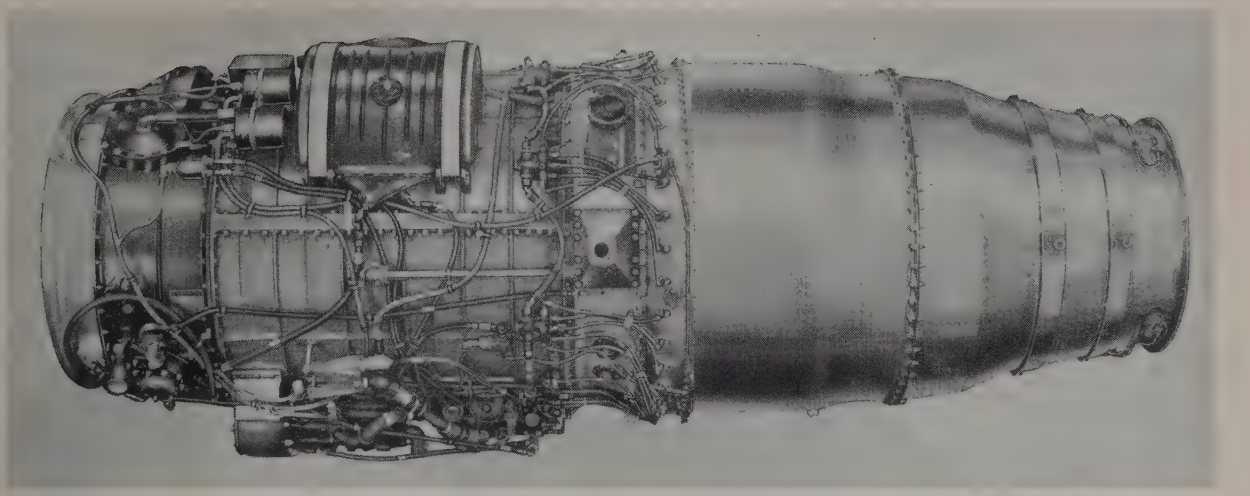
THE WRIGHT TJ38 ZEPHYR.

In April, 1957, Curtiss-Wright and Bristol Aero-Engines, Ltd., signed an agreement under which the American company acquired licence rights in the Bristol Olympus BOl.6 turbojet and its derivatives. The agreement also covered development by the combined resources of both companies of an engine tailored specially for the commercial market and combining features of the Olympus BOl.6 and Orpheus turbojets.

This engine, which has been given the name Zephyr, has a designed take-off rating of 12,500 lb. (5,670 kg.) s.t., which



The Wright J65-W-18 turbojet engine (10,500 lb.=4,770 kg. s.t. with afterburner).



The Wright J65-W-7 turbojet engine (7,800 lb.=3,538 kg. s.t.)

WRIGHT J65 ENGINE DATA.

Engine Model	S/L. Static Thrust (dry)	S/L. Static Thrust (augmented)	Dry weight less tailpipe	Length with tailpipe	Maximum Diameter	Remarks
J65-W-5	7,200 lb. (3,266 kg.)	—	2,750 lb. (1,247 kg.)	109 in. (2,769 mm.)	37.5 in. (953 mm.)	In Martin B-57A and B, RB-57A
J65-W-7	7,800 lb. (3,538 kg.)	—	2,795 lb. (1,268 kg.)	115 in. (2,921 mm.)	37.5 in. (953 mm.)	In Republic XF-84F
J65-W-16	7,700 lb. (3,493 kg.)	—	2,742 lb. (1,244 kg.)	122 in. (3,098 mm.)	37.5 in. (953 mm.)	In North American FJ-3 and FJ-4 and Douglas A4D-2
J65-W-18	7,450 lbs. (3,382 kg.)	10,500 lb. (4,770 kg.)	3,425 lb. (1,554 kg.)	182 in. (4,620 mm.)	37.5 in. (953 mm.)	In Grumman F11F-1

remains constant up to an ambient temperature of 100°F.

The Zephyr is a two-spool turbojet, with a five-stage low-pressure compressor, seven-stage high-pressure compressor, "cannular" type combustion chamber with eight flame-tubes, single-stage high-pressure turbine and single-stage low-pressure turbine. It has a compression ratio of 10.5 : 1.

DIMENSIONS.—
Diameter 41 in. (1,040 mm.).
Length, intake to exhaust flange 121 in. (3,075 mm.).

WEIGHT.—
Dry, with accessories, 3,946 lb. (1,790 kg.).

PERFORMANCE RATINGS.—
Take-off thrust 12,500 lb. (5,670 kg.).
Cruising thrust at Mach 0.8 at 36,089 ft. (11,000 m.) 3,000 lb. (1,360 kg.).

FUEL CONSUMPTIONS.—
At take-off thrust 0.718 lb./lb. s.t./hr. (0.718 kg./kg. s.t./hr.).
At cruising thrust 0.88 lb./lb. s.t./hr. (0.88 kg./kg.s.t./hr.).

THE WRIGHT TJ37.

The TJ37 is the designation of the Bristol Orpheus 810 for which Curtiss-Wright has a manufacturing licence. The Orpheus (4,850 lb.=2,200 kg. s.t.) powers the two prototypes of the Lockheed CL-329 JetStar light twin-jet transport. The installed engines are of Bristol manufacture but the TJ37 will be offered as a standard power-plant should the JetStar go into production.

DIMENSIONS.—
Diameter 32.4 in. (823 mm.).
Length 76.5 in. (1,943 mm.).

WEIGHT.—
Dry 990 lb. (449.5 kg.).

PERFORMANCE.—
Take-off output 4,850 lb. (2,200 kg.) s.t. at sea level.

THE WRIGHT J65.

TYPE.—Axial-flow Turbojet.

AIR INTAKE.—Annular type surrounding front main bearing support.

COMPRESSOR.—Thirteen-stage axial-flow, first seven stages forming low-pressure section and last six high-pressure section. Rotor blades secured in steel discs shrunk on hollow aluminium-alloy shaft. First three rows of blades are of steel and secured in discs by "fir-tree" roots. Remaining rows of blades, four of aluminium-alloy and last six of stainless steel, secured between pairs of discs by rivets. One row of inlet guide vanes and all stator blades secured by serrations in carrier rings, which are split for ease of assembly in compressor case. Inlet guide vanes and first seven rows of stator blades are shrouded. Compressor shaft carried on ball-bearing (front) and roller bearing (rear). Compressor casing, an aluminium casting, is split on horizontal centre-line.

COMBUSTION CHAMBER.—Single annular type with inner and outer stainless steel liners between which combustion takes place. Thirty-six Armstrong Siddeley type fuel-air vaporisers. Fuel and primary air fed into hook-shaped vaporiser tubes whose open ends point upstream. Secondary air enters chamber through 36 air distributing cups to mix with combustion flame near vaporiser tubes.

FUEL SYSTEM.—Low pressure type.

FUEL GRADE.—Mil-L-5624A (JP4).

NOZZLE GUIDE VANES.—Aerofoil type.

TURBINE.—Two-stage turbine. Steel discs coupled together by taper pins. First-stage disc has 110 buckets, second-stage 75 buckets, all secured by "fir-tree" roots and locking plates. Blades of nickel-base alloy. Front turbine disc attached by taper pins to turbine rotor stub shaft. This is splined to turbine rotor shaft coupling, front end of turbine rotor shaft, in turn, being bolted to compressor rotor shaft drive coupling. Roller bearing in front of rotor disc assembly. Gas temperatures 1,476°F. before turbine, 1,112°F. after turbine.

JET PIPE.—Fixed type. Steel jet pipe and inner cone.

ACCESSORY DRIVE.—Off extension of compressor shaft in front main bearing support.

LUBRICATION SYSTEM.—Closed system. Oil tank (5 U.S. gallons=18.9 litres capacity) located on upper port side of compressor casing. One gear-type pressure pump, one gear-type scavenge pump and two piston-type metering pumps. Normal oil pressure 24-40 lb./sq. in. (1.69-2.81 kg./cm.^{2}).

OIL SPECIFICATION.—Mil-L-7808.

MOUNTING.—Three-point suspension, one stabilising support at front and two trunnions at centre main bearing support on horizontal centre-line.

STARTING.—Combustion cartridge or electric starter/generator in bullet fairing on nose. Primers and igniters in combustion chamber. Electrical and ignition systems interconnected for automatic starting.

DIMENSIONS, WEIGHTS AND PERFORMANCE RATINGS.—See Table.

THE CURTISS-WRIGHT XLR25-CW-1.

The XLR25 is a throttleable liquid-propellent rocket motor which the Curtiss-Wright Propeller Division developed for the Bell X-2 ultra-high-speed research aircraft. It has one large and one small regeneratively-cooled chambers, into which the propellents are fed by a turbo-pump group driven by a self-contained system, under the control of pilot-operated electro-hydraulic throttles. The main chamber is rated at approximately 8,000 lb. (3,630 kg.) s.t. and the auxiliary (cruising) chamber at 4,000 lb. (1,815 kg.) s.t.

PART 2—PISTON ENGINES

GREAT BRITAIN

ALVIS

ALVIS LTD.

HEAD OFFICE AND WORKS: HOLYHEAD ROAD, COVENTRY.

Directors: J. J. Parkes, F.R.Ae.S. (Chairman and Managing Director), R. W. Rutledge, H. J. Nixon, G. R. Howell and Capt. H. S. Harrison-Wallace, D.S.O., R.N. (Retd.).

Sales Manager, Aero Division: T. C. Wallace.

The current products of the Alvis company are the nine-cylinder Leonides and 14-cylinder Leonides Major, both of which are available for fixed-wing installations and as power plants for helicopters with either right or left-hand rotation.

THE ALVIS LEONIDES.

TYPE.—Nine-cylinder radial air-cooled, geared and supercharged.

CYLINDERS.—Bore 4.8 in. (122 mm.). Stroke 4.41 in. (112 mm.). Capacity 718.6 cub. in. (11.78 litres). Compression ratio 6.5 : 1. Nitrided steel barrels with cast Y-alloy heads screwed and shrunk on. Both barrels and heads are deeply finned.

PISTONS.—Forged Y-alloy with internal finning below crown. Two compression and two scraper rings, one scraper at skirt rest above gudgeon-pin. Fully-floating gudgeon-pins with washers and circlips.

CONNECTING RODS.—I-section master-rod and I-section auxiliary rods machined from high-grade steel. Master-rod has white-metalled steel shell big-end bearing. All other bearings have bronze bushes.

CRANKSHAFT. — Single-throw shaft with divided crank-pin. The divided pin is serrated internally for a mating and serrated steel coupling. Shaft runs in two uncaged roller bearings and one ball thrust bearing.

CRANKCASE.—Cast in two halves in L.51 alloy.

VALVE GEAR.—Two inclined valves per cylinder with independent rocker system completely enclosed. Both valves of austenitic steel, the exhaust valve sodium-cooled and with "bright-ray" covered head and seats. Cam-ring two-track cam disc, each track with four cams operating roller followers housed in removable tappet guides in crankcase.

INDUCTION.—Hobson automatic low-pressure fuel injector. Induction system incorporates air-cleaning and de-frosting with oil-heated throttles and throttle housing.

SUPERCHARGER.—Single-speed single-stage centrifugal blower. Supercharger ratio 6.5 : 1.

FUEL.—100/130 Grade (DERD 2485). Lower grades can be used after incorporation of minor modifications.

IGNITION.—Two B.T.H. type C.9B/2 (C.9A/3 in Type 521/1, 521/2 and 523/1 engines) magnetos mounted on rear cover and driven by B.T.H. couplings. Two plugs per cylinder, Lodge type LA.1/2. Plessey fully-screened harness.

LUBRICATION.—Dry sump system. One pressure pump and two scavenge pumps. Normal oil pressure 60-80 lb./sq. in. (4.2-5.6 kg./cm.^{2}). Inlet temperature (max.) 85°C. Outlet temperature (approx.) 110°C. Normal oil flow 300 gallons (1,364 litres) per hour.

REDUCTION GEAR.—Farman type epicyclic. Gear ratio 0.625 : 1 or 0.50 : 1.

AIRSCREW SHAFT.—No. 3 size L.H. rotation. Constant-speed governor unit driven through bevels mounted on front of cam gearing drive-shaft. Operating oil passes through annular channels and drilling in special oil transfer unit located inside stationary bevel of reduction gear.

ACCESSORIES.—Mounted on rear cover and comprising Newton type HX2 generator, Smiths Mk. VIIIB r.p.m. drive, Hymatic type SH 6/10C air compressor with Rotol half-speed gearbox type ARG1/8E, Lockheed Mk. VI Series 1 hydraulic pump and Plessey B.3X Mk. II vacuum pump.

MOUNTING.—Dynafocal flexible type with four pin-jointed attachments.

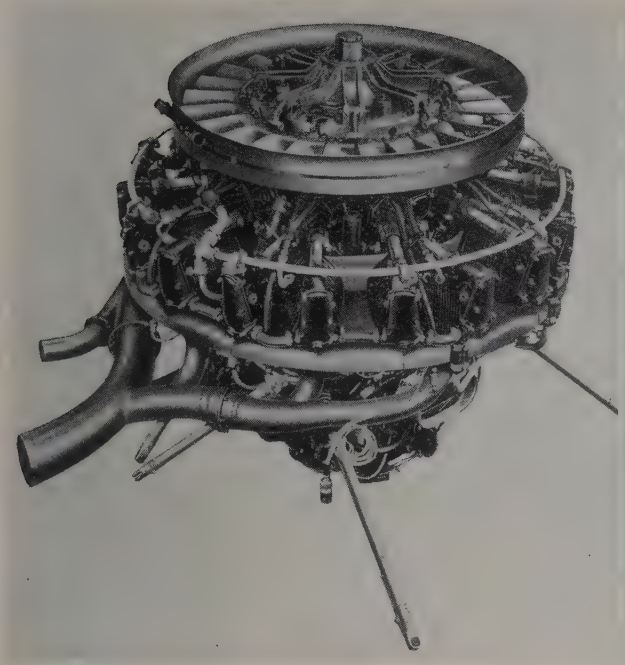
STARTING.—Plessey cartridge, or Rotax hand/electric starter (with feathering pump drive on all engine types except 521/1, 521/2 and 524/1).

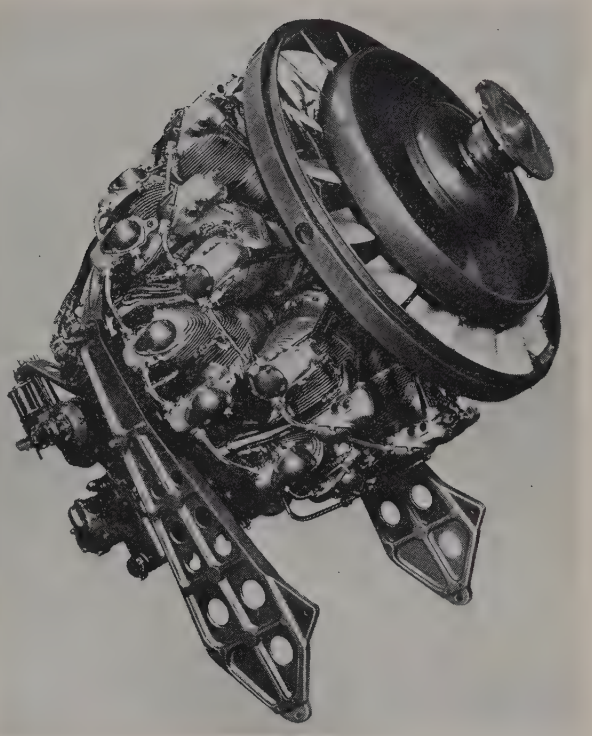
DIMENSIONS, WEIGHTS AND PERFORMANCE.—See Table.

CONSUMPTIONS.—
Fuel (at max. continuous power) 48.5 Imp. gallons (220.5 litres) per hour.
Oil 4 to 9 pints (2.2 to 5.1 litres) per hour.

ALVIS LEONIDES AND LEONIDES MAJOR RADIAL AIR-COOLED ENGINES.

Model	Bore and Stroke	Swept Volume	Take-off Power	Max. Continuous Rating	Max. Power Rating	Nett Dry Weight	Reduction Gear Ratio	Dimensions		Remarks
								Diameter	Length	
Leonides 503/4	4.80 in. (122 mm.) × 4.41 in. (112 mm.)	718.6 cub. in. (11.78 litres)	520/540 h.p.	460 h.p. at 6,000 ft. (1,830 m.)	545 h.p. at 1,750 ft. (535 m.)	795 lb. (361 kg.)	.625 to 1	41.5 in. (1,054 mm.)	54.4 in. (1,382 mm.)	Leonides 503/5 similar except dry weight 800 lb. (363 kg.)
504/5	4.80 in. (122 mm.) × 4.41 in. (112 mm.)	718.6 cub. in. (11.78 litres)	520/540 h.p.	490 h.p. at 3,750 ft. (1,140 m.)	545 h.p. at 1,750 ft. (535 m.)	800 lb. (363 kg.)	.625 to 1	41.5 in. (1,054 mm.)	54.4 in. (1,382 mm.)	—
504/7	4.80 in. (122 mm.) × 4.41 in. (112 mm.)	718.6 cub. in. (11.78 litres)	520/540 h.p.	490 h.p. at 3,750 ft. (1,140 m.)	545 h.p. at 1,750 ft. (535 m.)	810 lb. (367 kg.)	.625 to 1	41.5 in. (1,054 mm.)	54.4 in. (1,382 mm.)	Leonides 504/8 similar except reduction gear ratio .5 : 1
514/7 and 514/8A	4.80 in. (122 mm.) × 4.41 in. (112 mm.)	718.6 cub. in. (11.78 litres)	540/560 h.p.	500 h.p. at 3,750 ft. (1,140 m.)	570 h.p. at 1,750 ft. (535 m.)	810 lb. (367 kg.)	.625 to 1	41.5 in. (1,054 mm.)	54.4 in. (1,382 mm.)	514/8A has .5 : 1 reduction gear ratio
521/1	4.80 in. (122 mm.) × 4.41 in. (112 mm.)	718.6 cub. in. (11.78 litres)	480/500 h.p.	405 h.p. at 8,250 ft. (2,515 m.)	515 h.p. at 3,750 ft. (1,140 m.)	790 lb. (358 kg.)	.8 : 1	41.5 in. (1,054 mm.)	54.96 in. (1,397 mm.)	Vertical mounting
523/1	4.80 in. (122 mm.) × 4.41 in. (112 mm.)	718.6 cub. in. (11.78 litres)	520/540 h.p.	460 h.p. at 6,000 ft. (1,830 m.)	545 h.p. at 1,750 ft. (535 m.)	790 lb. (358 kg.)	.8 : 1	41.5 in. (1,054 mm.)	54.96 in. (1,397 mm.)	Vertical mounting
524/1	4.80 in. (122 mm.) × 4.41 in. (112 mm.)	718.6 cub. in. (11.78 litres)	500/520 h.p.	390 h.p. at 9,250 ft. (2,820 m.)	540 h.p. at 4,750 ft. (1,450 m.)	730 lb. (331 kg.)	Nil	41.5 in. (1,054 mm.)	32.8 in. (833 mm.)	Vertical mounting
Leonides Major 702/1	4.80 in. (122 mm.) × 4.41 in. (112 mm.)	1,118.4 cub. in. (18.33 litres)	875 h.p.	735 h.p. at 6,500 ft. (1,980 m.)	885 h.p. at 1,500 ft. (460 m.)	1,200 lb. (545 kg.)	.533 to 1	38.9 in. (988 mm.)	62.1 in. (1,575 mm.)	—
Leonides Major Mk. 151	4.80 in. (122 mm.) × 4.41 in. (112 mm.)	1,118.4 cub. in. (18.33 litres)	—	690 h.p. at 7,000 ft. (2,135 m.)	860 h.p. at 1,000 ft. (305 m.)	1,050 lb. (476 kg.)	Nil	38.9 in. (988 mm.)	54.9 in. (1,394 mm.)	Vertical mounting
Leonides Major Mk. 155	4.80 in. (122 mm.) × 4.41 in. (112 mm.)	1,118.4 cub. in. (18.33 litres)	—	705 h.p. at 6,750 ft. (2,055 m.)	780 h.p. at 3,250 ft. (990 m.)	1,050 lb. (476 kg.)	Nil	38.9 in. (988 mm.)	54.9 in. (1,394 mm.)	Vertical to horizontal





Above, the Alvis Leonides 521/1 and, right, the Leonides Major helicopter engines.

THE ALVIS LEONIDES HELICOPTER ENGINE.

There are two versions of this engine, of which the Series 524 powers the Bristol Type 171 helicopter and the Series 521 the Westland Dragonfly helicopter. The differences are as follows :—

Series 521. Basically as standard Leonides, but with crankshaft arranged to run vertically. Fitted with 0.8 : 1 reduction and reversing gear giving right-hand rotation.

Series 524. Basically similar to the standard Leonides, but with the oil pumps and sump mounted in the rear cover in order that the engine can run with the crankshaft in the vertical plane. No reduction gear is fitted, but in its place is a centrifugally-operated clutch with integral cooling fan blades.

THE ALVIS LEONIDES 530 SERIES.

Developed as a private venture, the 530 series is a long-stroke version of the Leonides with an initial rating of 600 h.p. at sea level. The first engines of this series have a standard rear cover. Later models will have a revised rear section, with a supercharger of increased capacity, offering a considerable improvement in performance at altitude.

Suitable for the Scottish Aviation Twin Pioneer, the 530 series engine was run for the first time in October, 1957, and passed its Type Test in August, 1958.

THE ALVIS LEONIDES MAJOR.

There are two basic versions of the Leonides Major, for fixed-wing aircraft and for helicopter installations. The description below refers specifically to the fixed-wing version, the helicopter version being described individually later under its own heading.

TYPE.—14-cylinder two-row air-cooled radial, geared and supercharged.

CYLINDERS.—Bore 4.80 in. (122 mm.). Stroke 4.41 in. (112 mm.). Swept volume 1,117.8 cub. in. (18.34 litres). Compression ratio 6.8 : 1. Nitrided steel barrels, deeply finned, with cast "Y" alloy heads screwed and shrunk on.

PISTONS.—Forged "Y" alloy, with internal finning below crown. Two compression and two scraper rings, one scraper at skirt, rest above gudgeon-pin. Fully-floating gudgeon-pins with washers and circlips.

CONNECTING RODS.—I-section master-rods and I-section auxiliary rods machined from high-grade steel. Master-rods have white-metalled steel shell big-end bearings; all other bearings have bronze bushes.

CRANKSHAFT.—Two-throw three-piece shaft machined from high-grade steel. Three roller bearings and one ball-bearing to govern end float.

CRANKCASE.—Three-piece case die-forged in light alloy.

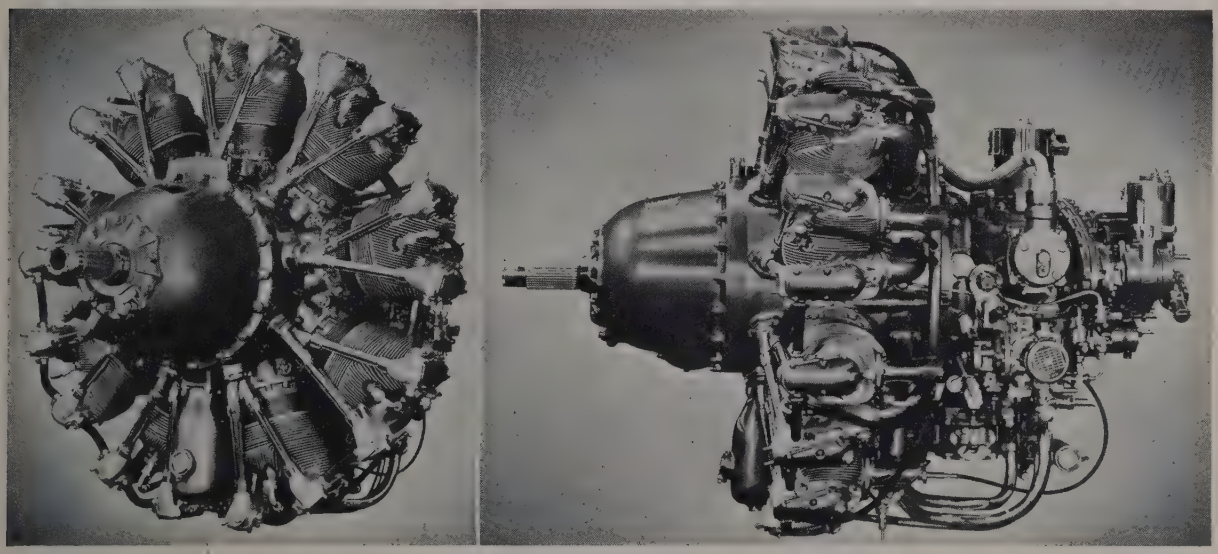
VALVE GEAR.—Two inclined valves per cylinder. Both valves of austenitic steel, exhaust valve sodium-cooled and with Brightray-covered head and seats. Two double-tracked cam discs, each track with three cams operating roller followers.

INDUCTION.—Low-pressure fuel injection. Hobson or S.U. fuel pump and fuel injectors.

SUPERCHARGER.—Single-stage single-speed centrifugal blower. Spring drive. Gear ratio 6.5 : 1.

FUEL. — 100/130 Grade (DERD 2485). Lower grades can be used after incorporation of minor modifications.

IGNITION.—Two B.T.H. Type C.14.C/1 magnetos on rear cover. Two Lodge LA1/2



The Alvis Leonides nine-cylinder radial air-cooled engine.

plugs per cylinder. Plessey fully-screened ignition harness.

LUBRICATION.—Dry sump type. One pressure pump and two scavenge pumps.

REDUCTION GEAR.—Farman type epicyclic gear with fixed bevel and six satellite pinions. Gear ratio 0.533 : 1.

AIRSCREW SHAFT.—No. 4 size L.H. rotation.

ACCESSORY DRIVE.—Provision for all normal accessories on rear cover, with direct drive.

ACCESSORIES.—Rotax type B.2104 generator, Smiths type VIIIC r.p.m. drive, Hymatic type S.50U or Dunlop Mk. 1 air compressor, Lockheed Mk. VII Series 1 hydraulic pump, Plessey B.3X Mk. II vacuum pump.

STARTING.—Rotax hand/electric type C.1254 or Plessey cartridge M.5 Mk. 2 or M.6 Mk. 2.

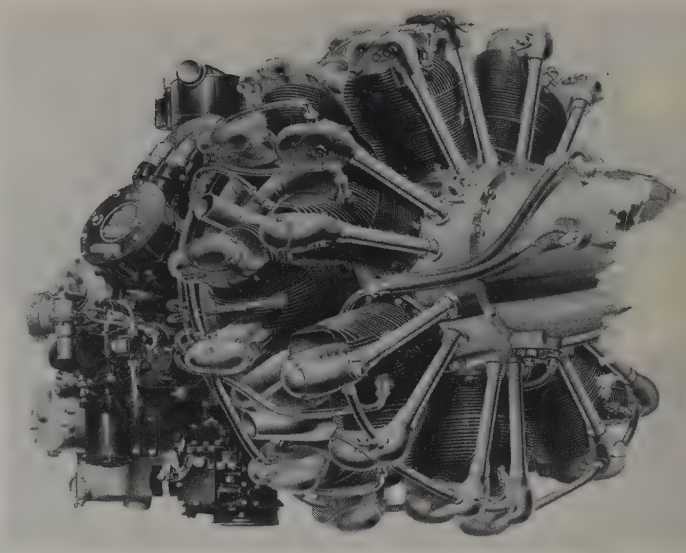
MOUNTING.—Dynafocal mounting with four pick-up points.

DIMENSIONS, WEIGHTS AND PERFORMANCE.—See Table.

CONSUMPTIONS.—
Fuel (at max. continuous power) 69.4 Imp. gal. (297 litres) per hour.
Oil 6-12 pints (3.4-6.8 litres) per hour.

THE ALVIS LEONIDES MAJOR HELICOPTER ENGINE.

There are two versions of this engine. That used in the Bristol 173 Series helicopter is similar to the standard Leonides Major, but with crankshaft arranged to run vertically. There is no reduction gear but it is fitted with either a centrifugal or manually operated clutch with integral cooling fan.



The 885 h.p. Alvis Leonides Major two-row radial engine.

The second version, used in the Westland Whirlwind H.R. Mk. 5, is arranged for right-hand rotation, and fitted with clutch and cooling fan. The positioning of the sump and oil pumps enables this engine to run in any position between vertical and horizontal to suit the aircraft installation.

BRISTOL

BRISTOL AERO-ENGINES, LTD.

HEAD OFFICE, WORKS AND AERODROME : FILTON, NR. BRISTOL.

LONDON OFFICE : 6, ARLINGTON STREET, ST. JAMES'S, S.W.1.

Directors : Sir W. Alec Coryton, K.C.B., K.B.E., M.V.O., D.F.C. (Chairman and Managing Director) ; Sir W. Reginald Verdon Smith, M.A., B.C.L., J.P. ; Brian Davidson ; F. R. Banks, C.B., O.B.E., F.R.Ae.S., M.I.Mech.E., F.Inst.Pet. ; Dr. S. G. Hooker, O.B.E., D.Phil., D.I.C., F.R.Ae.S. (Chief Engineer) ; G. L. Hack, M.I.Mech.E. (Works Director) ; John Innes, O.B.E., M.A. ; R. L. Ninnes, F.R.Ae.S. ; Dr. E. Warlow Davies, D.Phil., B.A., B.Sc. (Deputy Chief Engineer) ; F. M. Burns (Financial).

General Manager : D. A. Fairnie, B.Sc., M.I.Prod.E.

Secretary : D. Railton.

The Bristol Aeroplane Co., Ltd. was originally founded in 1910 but it did not enter the aero-engine field until 1920, when an Aero-engine Department was established to design and manufacture radial air-cooled engines.

With the progressive growth of the company's aviation activities at home and abroad, the Bristol Aeroplane Co., Ltd. decided late in 1955 to transfer the activities of its individual divisions to the control of separate subsidiary companies. As part of the re-organisation, a new company known as Bristol Aero-Engines, Ltd. was incorporated. It took over the assets and liabilities of the Aero-Engine Division on January 1, 1956.

In addition to the headquarters factory at Filton, the company has a components factory at Sunderland, overhaul base at Whitchurch and satellite drawing offices in London and Cardiff.

The first post-war range of Bristol civil engines were in the Hercules 630 Series. These engines were essentially similar to the military Hercules 100 Series except that they had single-speed superchargers.

These engines were followed by the post-war 200 and 700 Series which had many new features, including copper-based cylinder-heads and a stiffened power section.

The Hercules 800 Series have a further stiffening of the power section and, with water/methanol injection, develop 2,300 h.p. for take-off.

Hercules 106 engines which powered the Handley Page Hastings transport have been replaced by a new version of this engine, the Mk. 216, to provide better performance and a longer period between overhauls.

The civil 630 Series engines have been used in the Short Solent, Vickers Viking and Bristol Freighter. These engines have an approved overhaul life of 1,500 hours, and this period is likely to increase. The 730 Series engine powers the Spanish CASA Azor transport.

The immediate post-war Centaurus engines were the Mks. 18 and 57. The full post-war types were introduced initially in 1949 and comprised the civil 660 Series and, in 1953, the military Mk. 173.

The Centaurus 661 is employed in the Airspeed Ambassador, or "Elizabethan" class, airliners and is approved for a life of 1,700 hours between overhauls. The military version, the Centaurus 173, powers the Blackburn Beverley heavy freighter in service with the R.A.F. A later development of this engine, the Centaurus 373, is fitted with a direct fuel-injection system and, with methanol/water injection, develops 3,150 h.p. for take-off.

It is worth noting that all Bristol engines have a name and mark number. Mark numbers below 500 are applied to military engines, while numbers above 500 distinguish civil engines.

Details of Bristol gas-turbine engines will be found in Part I of this Section.

THE BRISTOL CENTAURUS.

The latest marks of Centaurus civil engines are of the 660 series and have two-speed superchargers. They are fitted with copper-based cylinder heads, and embody the necessary drive and face for an airscrew reversing pump, together with a 150 h.p. accessory drive.

The following are the principal current versions of the Centaurus :—

Centaurus 660 Series. Twin-entry two-speed supercharged engines with front ignition system, provision for feathering and reversing airscrew, copper-based cylinder heads and high-power accessory drive (150 h.p.). The engine is mounted on a dynamic-type flexible mounting.

Centaurus 173. Twin-entry single-speed supercharged engine with dynamic flexible mounting, copper-based head, methanol-water injection, etc.

Centaurus 373. Basically similar to the Centaurus 173, but having a direct fuel-injection system instead of the bulk fuel injector. Two nine-cylinder pumps at the rear of the engine supply metered fuel to the injection nozzles, one in each cylinder-head. As with the bulk injector, pump output is controlled by engine r.p.m., supercharger pressure and temperature, and exhaust back pressure.

The description which follows refers to the Type 173.

TYPE.—Eighteen-cylinder two-row air-cooled sleeve-valve radial with single-speed supercharger.

CYLINDER ASSEMBLY.—Bore 5.75 in. (146 mm.). Stroke 7 in. (178 mm.). Swept volume 3,270 cub. in. (53.6 litres). Open ended light alloy barrels with deep closely pitched fins, machined from solid. Cylinder heads fabricated, with finned copper base and steel body.

SLEEVE DRIVE.—By simple spur gear trains from front and rear ends of crankshaft, driving short cranks for the front and rear banks respectively. Each sleeve crank is carried at one end in a plain bearing in the crankcase, and at the other end in a plain bearing in the enclosing casing, through which pressure oil is supplied for the sleeve ball assemblies. The cranks run at one-half engine speed. Intermediate gears are carried on needle roller-bearings.

PISTONS.—Fully skirted type, with three wedge-section gas rings above the gudgeon-pin and one bevelled scraper ring in the skirt. Fully-floating gudgeon-pins in pistons and small-ends of connecting-rods.

CONNECTING RODS.—Front and rear assemblies each comprising a master-rod, bearing directly on the white-metalled crankpin sleeve, and eight articulated rods carried in the master-rod.

CRANKSHAFT.—Three-piece built-up type carried in four roller main bearings. Crankpins formed integral with centre-section, and fitted with white-metalled steel sleeves for big-end bearings.

CRANKCASE.—In three sections, carrying housing for the main bearings and sleeve crank bearings.

FRONT COVER.—Encloses the front bank sleeve-drive mechanism and has a flange and drive for the combined constant-speed unit and airscrew reversing pump, and ignition distributors. There is a small oil pump in the base of the casting to return surplus oil from the front of the engine to the sump.

SUPERCHARGER AND INDUCTION SYSTEM.—Single-speed centrifugal supercharger, housed in a light-alloy casing. The aluminium-alloy impeller is of the double-shrouded type, and has a guide vane rotor mounted with it as an integral unit on the hollow

alloy-steel impeller shaft. The drive to the impeller shaft is taken from the rear of the crankshaft through spur gear trains. A vaned diffuser ring encircling the impeller passe[s] [pr]essed mixture to the [ch]amber formed in the [ca]sing, whence eighteen [al]-alloy induction pipes lead to the cylinders. The supercharger casing incorporates drives and faces for engine accessories, including the ignition generators, the [oil] pump and an [S.U.] electric starter. The cover is replaced by a simple [cover which] closes the rear of the supercharger and provides a bearing for the 150 [h.p.] drive.

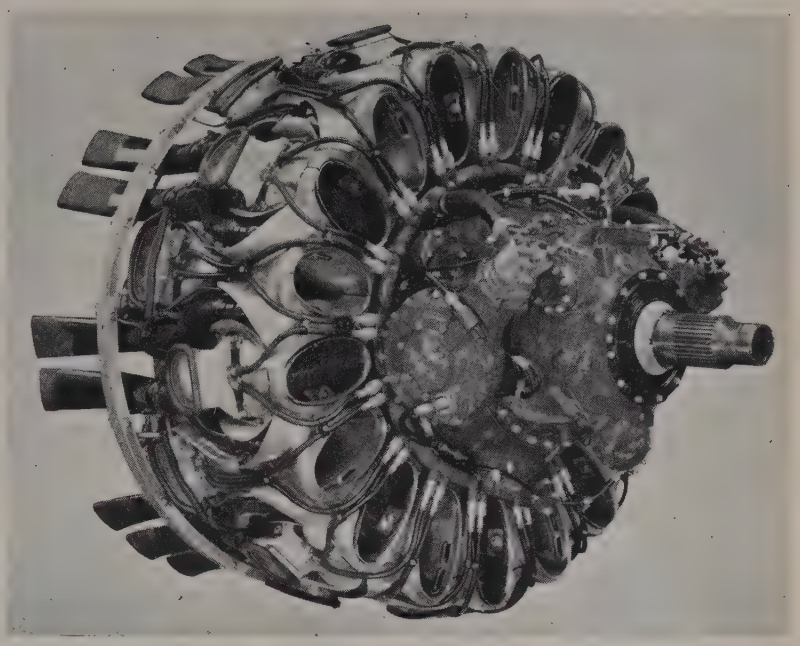
[The] Hobson-R.A.E. injector is [fed] by two spray nozzles, one in [each] side. The fuel pump is an integral [part] of the injector and is driven from a gear [on] the supercharger casing.

IGNITION SYSTEM.—Twin L.T. generators mounted at the rear of the engine supply twin H.T. transformers and distributors on the front cover. Two plugs in each cylinder are separately supplied by each distributor through leads enclosed in a waterproof screened harness.

LUBRICATION SYSTEM.—Direct pressure lubrication from oil pump in the sump through hollow main driving shaft and crankshaft to supply pressure oil to the supercharger, big end bearings and reduction gear. Separate pressure lines delivering oil to the sleeve driving mechanism. Pistons and sleeve splash-lubricated and supplemented by oil jets in the crankshaft. Oil in sump returned to tank by scavenge pump which is integral with pressure pump.

REDUCTION GEAR.—Epicyclic bevel type with a ratio of 0.40 : 1. The gears are located by spherical seats, spreading the load evenly over the three bevel pinions. Rear bevel wheel is driven from the crankshaft through a toothed coupling. All engines bearing an odd type number (*e.g.* Centaurus 173 etc), have a torquemeter built integral with the reduction gear.

DIMENSIONS, WEIGHTS AND PERFORMANCE.—See Table.



The 2,850 h.p. Bristol Centaurus 173 engine.

THE BRISTOL HERCULES.

The Hercules is by far the most widely used of the Bristol sleeve-valve engines. There are many types, which divide into the following main current groups :—

Hercules 630 and 670 Series. Single-speed supercharged civil versions of the Hercules 100.

Hercules 230 Series. Single-speed supercharger, copper-based cylinder heads and stiffened power section, for military applications.

Hercules 730 Series. Civil version of Hercules 230 Series.

Hercules 750 Series. Similar to Hercules 730 Series, but with provision for reversing airscrews and 36 h.p. accessory drive. The Hercules 758 is being built under licence in France by S.N.E.C.M.A.

Hercules 760 Series. Two-speed supercharged civil engine, with copper-based cylinder heads, provision for reversing airscrews and 150 h.p. accessory drive. Rated on 115/145 grade fuel.

Hercules 770 Series. Similar to Hercules 760, but rated on 100/130 Grade fuel, and with methanol/water injection for take-off. Supercharger locked in low gear.

Hercules 260 Series. Military version of Hercules 760 Series.

Hercules 815 Series. Similar to 750 Series but stiffened for higher rating and using water/methanol injection.

The description which follows refers to the Hercules 815.

TYPE.—Fourteen-cylinder two-row air-cooled sleeve-valve radial with single-speed supercharger.

CYLINDER ASSEMBLY.—Bore 5¾in. (146 mm.). Stroke 6½ in. (165 mm.). Swept volume 2,360 cub. in. (38.7 litres). Open-ended light alloy barrels with deep closely-pitched fins, machined from solid. Cylinder heads have finned copper bases and steel bodies.

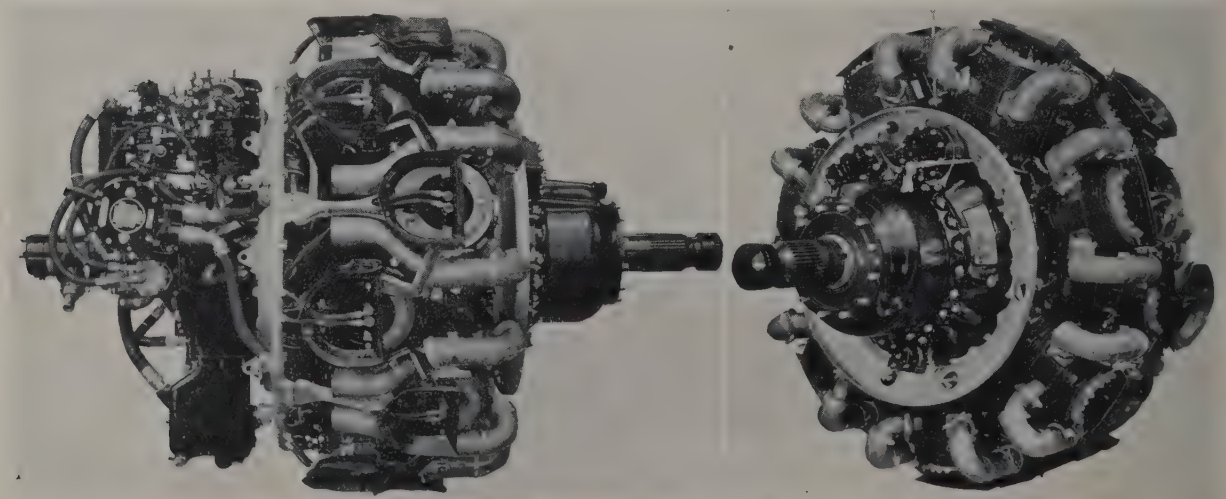
SLEEVE DRIVE.—By simple spur gear trains from the front end of the crankshaft, driving short cranks for the sleeves of the front bank and long cranks for the rear bank. Each sleeve crank is carried at one end in a self-aligning bearing in the crankcase, and at the other end in a plain bearing in the front cover, through which pressure oil is

BRISTOL CENTAURUS SLEEVE-VALVE RADIAL ENGINES.

	Bore and Stroke	Capacity	Air-screw Gear Ratio	Diameter	Weight (dry)	Take-off Power	Maximum Power for all-out level flight for 5 mins.	Normal Climb	Maximum Economical Cruising	Fuel Grade
CENTAURUS 661 (Civil)	5¾ in. × 7 in. (146 mm. × 178 mm.)	3,270 cub. in. (53.6 litres)	0.400 : 1	55.3 in. (1.405 m.)	3,460 lb. (1,570 kg.)	2,625 h.p. at 2,800 r.p.m.	2,705 h.p. at 2,800 r.p.m. at 4,000 ft. (1,220 m.)	2,265 h.p. at 2,500 r.p.m. at 5,500 ft. (1,680 m.) and 2,110 h.p. at 2,500 r.p.m. at 12,000 ft. (3,660 m.)	1,675 h.p. at 2,400 r.p.m. at 11,500 ft. (3,510 m.) and 1,575 h.p. at 2,400 r.p.m. at 17,500 ft. (5,335 m.)	100/130
CENTAURUS 662 and 663 (Civil)	5¾ in. × 7 in. (146 mm. × 178 mm.)	3,270 cub. in. (53.6 litres)	0.400 : 1	55.3 in. (1.405 m.)	Mk. 662 3,430 lb. (1,556 kg.) Mk. 663 3,465 lb. (1,572 kg.)	2,850 h.p. at 2,800 r.p.m. with methanol water	2,910 h.p. at 2,800 r.p.m. at 2,750 ft. (840 m.) with methanol water	2,265 h.p. at 2,500 r.p.m. at 5,500 ft. (1,680 m.) and 2,110 h.p. at 2,500 r.p.m. at 12,000 ft. (3,660 m.)	1,675 h.p. at 2,400 r.p.m. at 11,500 ft. (3,510 m.) and 1.575 h.p. at 2,400 r.p.m. at 17,500 ft. (5,335 m.)	100/130
CENTAURUS 173 (Military) and 673 (Civil)	5¾ in. × 7 in. (146 mm. × 178 mm.)	3,270 cub. in. (53.6 litres)	0.400 : 1	55.3 in. (1.405 m.)	3,400 lb. (1,542 kg.)	2,850 h.p. at 2,800 r.p.m. with methanol water	2,940 h.p. at 2,800 r.p.m. at 4,250 ft. (1,295 m.) with methanol water	2,370 h.p. at 2,500 r.p.m. at 5,000 ft. (1,525 m.)	1,720 h.p. at 2,400 r.p.m. at 11,500 ft. (3,510 m.)	100/130
CENTAURUS 373 (Military) and 873 (Civil)	5¾ in. × 7 in. (146 mm. × 178 mm.)	3,270 cub. in. (53.6 litres)	0.400 : 1	55.3 in. (1.405 m.)	3,490 lb. (1,583 kg.)	3,150 h.p. at 2,800 r.p.m. with methanol water	3,220 h.p. at 2,800 r.p.m. at 3,000 ft. (915 m.) with methanol water	2,590 h.p. at 2,600 r.p.m. at 5,500 ft. (1,680 m).	1,890 h.p. at 2,500 r.p.m. at 11,500 ft. (3,510 m.)	100/130

BRISTOL HERCULES SLEEVE-VALVE RADIAL ENGINES.

	Bore and Stroke	Capacity	Air-screw Gear Ratio	Diameter	Weight (dry)	Take-off Power	Maximum Power for all-out level flight for 5 mins.	Normal Climb	Maximum Economical Cruising	Fuel Grade
HERCULES 634 (Civil)	5¾ in. × 6½ in. (146 mm. × 165 mm.)	2,360 cub. in. (38.7 litres)	0.444 : 1	52 in. (1.32 m.)	Mk. 634 1,945 lb. (882 kg.) Mk. 638 1,955 lb. (886 kg.)	1,690 h.p. at 2,800 r.p.m.	1,780 h.p. at 2,800 r.p.m. at 6,500 ft. (1,981 m.)	1,510 h.p. at 2,400 r.p.m. at 3,750 ft. (1,143 m.)	1,315 h.p. at 2,400 r.p.m. at 8,250 ft. (2,514 m.)	100/130
HERCULES 637 and 672 (Civil)	5¾ in. × 6½ in. (146 mm. × 165 mm.)	2,360 cub. in. (38.7 litres)	0.444 : 1	52 in. (1.32 m.)	Mk. 637 1,980 lb. (898 kg.) Mk. 672 1,955 lb. (886 kg.)	1,690 h.p. at 2,800 r.p.m.	1,780 h.p. at 2,800 r.p.m. at 6,500 ft. (1,981 m.)	1,590 h.p. at 2,500 r.p.m. at 5,250 ft. (1,600 m.)	1,320 h.p. at 2,400 r.p.m. at 8,500 ft. (2,590 m.)	100/130
HERCULES 230 and 270 (Military)	5¾ in. × 6½ in. (146 mm. × 165 mm.)	2,360 cub. in. (38.7 litres)	0.444 : 1	52 in. (1.32 m.)	Mk. 230 2,115 lb. (960 kg.) Mk. 270 2,135 lb. (959 kg.)	1,925 h.p. at 2,800 r.p.m.	2,000 h.p. at 2,800 r.p.m. at 5,000 ft. (1,524 m.)	1,650 h.p. at 2,400 r.p.m. at 3,250 ft. (990 m.)	1,270 h.p. at 2,400 r.p.m. at 10,250 ft. (3,124 m.)	100/130
HERCULES 234 (Military) and 734 (Civil)	5¾ in. × 6½ in. (146 mm. × 165 mm.)	2,360 cub. in. (38.7 litres)	0.444 : 1	52 in. (1.32 m.)	Mks. 234, 734 2,115 lb. (960 kg.) Mks. 235, 735 2,150 lb. (975 kg.)	1,980 h.p. at 2,800 r.p.m.	2,020 h.p. at 2,800 r.p.m. at 2,750 ft. (838 m.)	1,660 h.p. at 2,500 r.p.m. at 4,500 ft. (1,372 m.)	1,220 h.p. at 2,400 r.p.m. at 10,500 ft. (3,200 m.)	100/130
HERCULES 733, 737, 758, 759 (Civil)	5¾ in. × 6½ in. (146 mm. × 165 mm.)	2,360 cub. in. (38.7 litres)	0.444 : 1	52 in. (1.32 m.)	Mks. 733, 737, 2,150 lb. (975 kg.) Mk. 758, 2,175 lb. (986 kg.) Mk. 759, 2,200 lb. (998 kg.)	2,040 h.p. at 2,800 r.p.m.	2,090 h.p. at 2,800 r.p.m. at 3,000 ft. (914 m.)	1,670 h.p. at 2,500 r.p.m. at 5,000 ft. (1,524 m.)	1,215 h.p. at 2,400 r.p.m. at 10,750 ft. (3,276 m.)	100/130
HERCULES 763 (Civil)	5¾ in. × 6½ in. (146 mm. × 165 mm.)	2,360 cub. in. (38.7 litres)	0.444 : 1	52 in. (1.32 m.)	2,395 lb. (1,086 kg.)	2,080 h.p. at 2,900 r.p.m.	2,140 h.p. at 2,900 r.p.m. at 3,750 ft. (1,143 m.)	1,655 h.p. at 2,500 r.p.m. at 5,750 ft. (1,753 m.) and 1,535 h.p. at 2,500 r.p.m. at 16,500 ft. (5,031 m.)	1,220 h.p. at 2,400 r.p.m. at 12,500 ft. (3,810 m.) and 1,135 h.p. at 2,400 r.p.m. at 22,250 ft. (6,782 m.)	115/145
HERCULES 264 (Military)	5¾ in. × 6½ in. (146 mm. × 165 mm.)	2,360 cub. in. (38.7 litres)	0.444 : 1	52 in. (1.32 m.)	2,305 lb. (1,045 kg.)	1,950 h.p. at 2,800 r.p.m.	1,990 h.p. at 2,800 r.p.m. at 2,750 ft. (838 m.)	1,605 h.p. at 2,400 r.p.m. at 2,750 ft. (838 m.) and 1,535 h.p. at 2,400 r.p.m. at 11,000 ft. (3,353 m.)	1,125 h.p. at 2,400 r.p.m. at 11,750 ft. (3,582 m.) and 1,065 h.p. at 2,400 r.p.m. at 19,500 ft. (5,950 m.)	100/130
HERCULES 216 (Military)	5¾ in. × 6½ in. (146 mm. × 165 mm.)	2,360 cub. in. (38.7 litres)	0.444 : 1	52 in. (1.32 m.)	2,205 lb. (1,000 kg.)	1,800 h.p. at 2,800 r.p.m.	1,925 h.p. at 2,800 r.p.m. at 8,750 ft. (2,650 m.)	1,550 h.p. at 2,500 r.p.m. at 10,000 ft. (3,050 m.)	1,150 h.p. at 2,400 r.p.m. at 15,750 ft. (4,800 m.)	100/130
HERCULES 815 (Civil)	5¾ in. × 6½ in. (146 mm. × 165 mm.)	2,360 cub. in. (38.7 litres)	0.444 : 1	52 in. (1.32 m.)	2,235 lb. (1,013 kg.)	2,300 h.p. at 2,900 r.p.m. with water methanol	2,310 h.p. at 2,900 r.p.m. at 500 ft. (153 m.) with water methanol	1,810 h.p. at 2,600 r.p.m. at 4,100 ft. (1,250 m.)	1,250 h.p. at 2,400 r.p.m. at 10,000 ft. (3,050 m.)	100/130



Two views of the 2,040 h.p. Bristol Hercules 758 sleeve-valve radial engine.

supplied for the sleeve ball assemblies. The cranks run at one-half engine speed and the intermediate gears are carried on needle roller-bearings.

Pistons.—Fully-skirted type, with three wedge-section gas rings above the gudgeon-pin and one bevelled scraper ring in the skirt. Gudgeon-pins fully-floating in pistons and small ends of connecting-rods.

Connecting Rods.—Front and rear assemblies each comprising a master-rod, bearing directly on the white-metalled crankpin sleeve and six articulated rods carried in the master rod.

Crankshaft. — Three-piece built-up type carried in four roller main bearings. Crankpins formed integral with centre section and fitted with white-metalled steel sleeves for big-end bearings.

Crankcase.—In three sections, carrying housings for the main bearings and sleeve crank bearings.

Front Cover.—Encloses the sleeve drive mechanism and has flanges and drives for the constant-speed unit and airscrew reversing pump. There is a small oil pump in the base of the casting to return surplus oil from the front of the engine to the sump.

Supercharger.—Single-speed supercharger with duplicate driving trains. Single down-draught intake and double-shrouded aluminium-alloy impeller. Individual induction pipes with screwed joints to all cylinders.

Rear Cover.—Carries the essential engine accessories, magnetos, starter and fuel pump, and embodies a high-powered accessory drive (150 h.p. max.) for cabin superchargers, etc.

Fuel System.—A Hobson-R.A.E. injector is fitted as standard.

Ignition System.—Two magnetos supply separately two plugs per cylinder. Waterproof and fully-screened ignition harness.

Lubrication System.—Direct pressure lubrication from oil pump in the sump through hollow main driving shaft and crankshaft, to supercharger, big end bearings and reduction gear. Separate pressure lines deliver oil to sleeve driving mechanism. Pistons and sleeves splash lubricated and supplemented by oil jets in the crankshaft. Oil in sump returned to tank by scavenge pump which is integral with pressure pump.

Reduction Gear.—Epicyclic bevel type with a ratio of 0.44 : 1. The front and rear bevels are located by spherical seats, spreading the load evenly over the three bevel pinions. Rear bevel wheel is driven from the crankshaft through a toothed coupling. Large diameter internal oil passages and oil transfer system ensure rapid propeller reversing. Torquemeter built integral with the reduction gear.

Dimensions, Weight and Performance.—See Table.

CIRRUS

CIRRUS ENGINE DIVISION, BLACKBURN AND GENERAL AIRCRAFT LTD.

Head Office and Works: Engine Dept., Brough, E. Yorks.

London Office: 43, Berkeley Square, London W.1.

Directors: E. Turner, A.C.A. (Chairman and Managing Director), Major F. A. Bumpus, B.Sc., A.R.C.S., Wh.Sc., F.R. Ae.S., N. E. Rowe, C.B.E., B.Sc., M.I. Mech.E., Whit.Ex., F.R.Ae.S., Sir Maurice Bonham Carter, K.C.B., K.C.V.O., Air Vice-Marshal H. N. Thornton, C.B.E., Marshal of the Royal Air Force Sir John C. Slessor, G.C.B., D.S.O., M.C.; T. Bancroft and A. F. Jopling.

General Manager: J. B. Bucher, Dip.Ing., M.I.Mech.E., M.I.E.S., M.I.S.I.

Sales Manager: Group-Capt. H. J. Wilson, C.B.E., A.F.C.

The Cirrus aero-engine, the pioneer light four-cylinder in-line air-cooled engine, made possible the light aeroplane of to-day, and its long list of successes in light aircraft of many types dates back to 1925.

The final production versions were the Cirrus Major Series 3 and Cirrus Minor Series 2A, many of which remain in service and which have been described fully in previous editions of "All the World's Aircraft."

During post-war years the Cirrus Engine Division has been developing direct petrol injection engines and the first of these to be completed and to pass the British Air Registration Board approval tests is the Bombardier, which powers the Auster Mk. 9 aircraft and is described below.

Production of the Bombardier was due to be phased out in 1958, but the production and supply of spares will continue.

The British manufacturing rights for Turbomeca gas-turbine engines were acquired in October, 1952. Details of these units will be found under "Blackburn-Turbomeca" in Part I of this Section.

THE CIRRUS BOMBARDIER 702.

The Bombardier is intended primarily for use with the Fairey Reed thin-boss fixed-pitch metal airscrew. If required an optional airscrew hub is available for use with a conventional thick-boss fixed-pitch airscrew, either metal or wood. The engine can also be adapted for the use of a constant-speed airscrew.

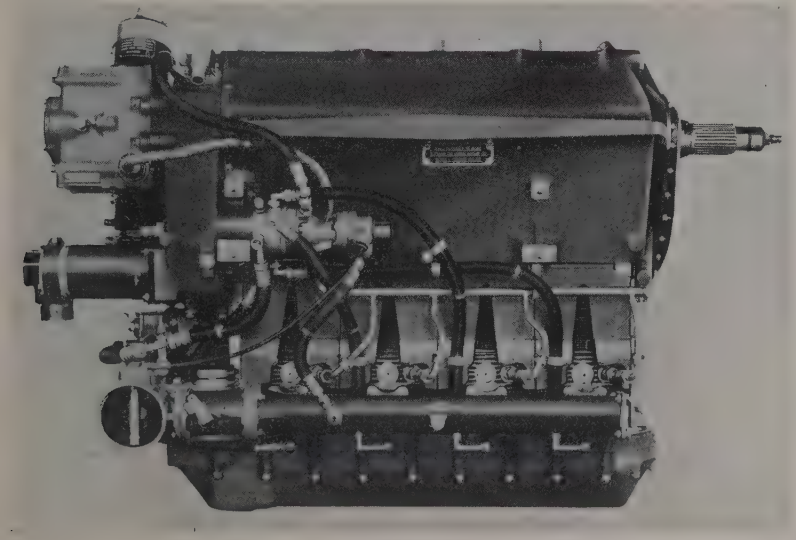
The engine is fitted with fuel-injection equipment and will be suitable for use with safety fuels when these become available. It powers the Auster Mk. 9 Aircraft.

Type.—Four-cylinder in-line inverted air-cooled. Direct drive L.H. tractor.

Cylinders.—Bore 4.8 in. (121.92 mm.). Stroke 5.5 in. (139.7 mm.). Capacity 398.12 cub. in. (6.524 litres). Compression ratio 7 : 1. High carbon steel barrels machined from solid, with Y-alloy pent-roof type head screwed on. Cylinders attached to crankcase by eight studs and nuts. Each cylinder head has fitted two sparking plug adapters, inlet and exhaust valve seat inserts and an adapter for a fuel injection nozzle.

Pistons.—Aluminium alloy slipper type. Two compression and one scraper ring. Fully floating gudgeon-pins located by end washers and circlips.

Connecting Rods.—H-section aluminium-alloy forgings with copper-lead steel-backed big-end bearings.



The 180 h.p. Cirrus Bombardier 702 engine.

Crankshaft.—Fully machined high tensile steel forging balanced statically and dynamically, running in five copper-lead steel-backed main journal bearings. Thrust bearing combined with front main journal bearing. Two integral collars on front end of shaft to take thrust.

Crankcase Assembly.—Magnesium-zirconium alloy castings, comprising front cover, crankcase, top cover and rear cover. Crankcase houses lower halves of main journal bearings and thrust bearing. Top cover houses upper halves of bearings and also carries the front lifting eye integral with top cover. Rear cover houses rear gear train and has mounting faces for fitting auxiliaries and accessories. Rear lifting eye integral with rear cover.

Valve Gear.—One inlet and one exhaust valve per cylinder. Camshaft carried in carrier plate and driven by vertical shaft through bevel gears. Valve operating gear enclosed in cover which acts as oil bath for valve gear and sump from which oil is scavenged.

Ignition.—B.T.H. Duplex magneto. Fully-screened ignition harness.

Fuel System.—Two Amal type 240/48 engine-driven fuel pumps supply fuel to S.U. injection pump driven from rear gear train. S.U. pump meters fuel through rigid injection pipes to fuel injection nozzles. Injection metering varied quantitatively with manifold pressure, air intake temperature and altitude by variation of pump stroke controlled by capsule and oil servo mechanism.

Fuel.—Gasoline, 91/98 Octane minimum.

Lubrication.—One pressure pump and duplex scavenge pump.

Accessories (Optional).—Plessey Type B3X Mk. 3 vacuum pump. Rotax type B1815 electric generator. Hymatic air compressor. Electric tachometer generator (unless C.S.U. is fitted). Constant speed unit. Mechanical tachometer.

Airscrew.—Standard, Fairey Reed Type 66960 thin-boss fixed-pitch metal airscrew. Optional, approved thick-boss fixed-pitch airscrews and approved constant-speed and variable-pitch airscrews.

Starting.—Rotax 24-volt electric (direct-cranking).

Cooling.—Air scoop and cylinder baffles supplied with engine.

Dimensions.—
Length overall 45.3 in. (1,152 mm.).
Height 30.95 in. (786 mm.).
Width 19 in. (483 mm.).

Net Dry Weight.—
Including fuel pumps, screened ignition and airscrew hub but excluding bearer feet and exhaust system 379 lb. (172 kg.) + 2½%.

Performance.—
Take-off 180 h.p. at 2,600 r.p.m. at sea level.
Max. continuous power rating 158 h.p. at 2,300 r.p.m. at 1,250 ft. (380 m.).
Max. weak mixture power 140 h.p. at 2,200 r.p.m. at 3,250 ft. (990 m.).

Fuel Consumptions.—
Max. take-off (upper limit) 13.75 Imp. gallons (62.42 litres) per hour.
Max. continuous (upper limit) 10.75 Imp. gallons (48.80 litres) per hour.

Oil Consumption.—
At max. continuous rating 1.0 to 3.5 pints (0.57 to 1.98 litres) per hour.

COVENTRY VICTOR

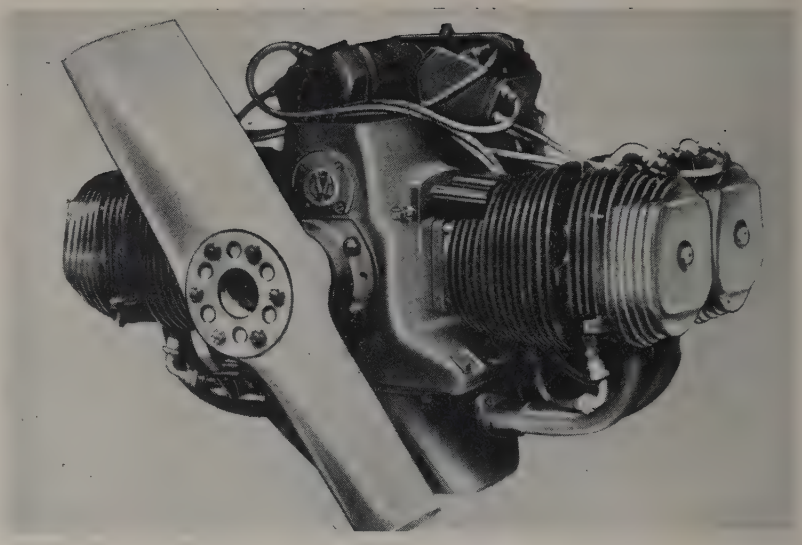
THE COVENTRY VICTOR MOTOR COMPANY, LTD.

HEAD OFFICE AND WORKS : COVENTRY.

Directors : Major W. A. Weaver, M.Inst.B.E., F.I.M. (Managing) ; S. J. Cordery ; G. R. Campion and W. Winters.

Long-famous as a manufacturer of horizontally-opposed piston-engines for industrial applications, the Coventry Victor Motor Company has now produced, at its own expense, a version of its Neptune four-cylinder engine expressly for use in light aircraft.

First tests of this engine, known as the Flying Neptune, were made in a Piper Cub airframe in 1955. No troubles were experienced in a 50-hour flight test programme and, after minor modifications, the engine was cleared for production.



The 55-60 h.p. Coventry Victor Flying Neptune engine.

THE COVENTRY VICTOR FLYING NEPTUNE.

TYPE.—Four-cylinder horizontally-opposed air-cooled.

CYLINDERS.—Bore 3.346 in. (85 mm.). Stroke 3.15 in. (80 mm.). Capacity 110.76 cub. in. (1,815 cc.). Compression ratio 6.5 : 1. Barrels cast in D.T.D. 424 aluminium alloy with pressed-in cast iron liners. Heat-treated cast aluminium alloy heads embody hemispherical combustion chambers with inclined hardened-steel valve inserts, and are each attached by four studs and nuts, passing through barrels and into crankcase.

PISTONS.—Aluminium pistons with two compression and one scraper rings, all above fully-floating hardened-steel gudgeon pins.

CONNECTING RODS.—High-tensile steel forgings with white metal steel-backed strip big-end bearings and bronze-bushed little-end bearings.

CRANKSHAFT.—One-piece low nickel-chrome content molybdenum steel forging to specification EN.110. Runs in three thin-wall main bearings with white metal steel-backed shells.

CRANKCASE.—Solution-treated Elektron C, with bolted-on sump of similar material.

VALVE GEAR.—Two inclined (inlet and exhaust) valves per cylinder of EN.59 austenitic steel. Valve seats are bichrome inserts, shrink-fitted in place. Camshaft, above and parallel to crankshaft, has silent chain drive.

INDUCTION SYSTEM.—Single Solex 40 WNH EO/2 carburettor mounted under sump. Single outlet bifurcates under centre of engine, each branch bifurcating again to intake ports.

IGNITION.—Two Lucas S.R. screened magnetos above engine, gear-driven from camshaft. Two Lodge Type C.B.14 sparkplugs per cylinder. Screened ignition harness.

LUBRICATION.—Wet-sump system, pressure-lubricating all main bearings and big ends. Gear-type oil pump. Easily detachable suction-type filter.

FUEL GRADE.—Standard premium grade, as obtainable from garages.

ACCESSORIES.—Tachometer driven from rear of camshaft by floating coupling.

STARTING.—By hand.

MOUNTING.—Two bearers, each with four ½ in. bolts.

DIMENSIONS.—
Width 30 in. (762 mm.).
Length 24.75 in. (629 mm.).
Height 22 in. (559 mm.).

WEIGHT (production form).—
210 lb. (95.25 kg.).

PERFORMANCE.—
Take-off power 55-60 h.p. at 3,200 r.p.m.
Continuous cruising power 44 h.p. at 2,600 r.p.m.

CONSUMPTIONS.—
Fuel at take-off power 0.53 pints (0.30 litres) per h.p./hr.
Oil approx. 0.125 pints (0.07 litres) per hr.

DE HAVILLAND

THE DE HAVILLAND ENGINE CO., LTD.

HEAD OFFICE : LEAVESDEN, HERTFORDSHIRE.

Directors : Sir Geoffrey de Havilland, C.B.E., A.F.C., F.R.Ae.S. (President) ; A. F. Burke, O.B.E., M.Inst.T., F.R.S.A. (Chairman) ; H. Buckingham (General Manager) ; W. E. Nixon, F.C.I.S. ; J. L. P. Brodie, M.I.A.E., M.I.Mech.E. ; Dr. E. S. Moult, C.B.E., Ph.D., B.Sc. (Eng.), M.I.Mech.E., F.R.Ae.S. ; and M. G. Ash.

The de Havilland Engine Co. Ltd. was formed in February, 1944, from the Engine Division of the de Havilland Aircraft Co., Ltd., and is now one of the three main operating subsidiaries in Great Britain of de Havilland Holdings, Ltd. In addition to its range of gas-turbine engines, the company continues to manufacture the well-known Gipsy four and six-cylinder air-cooled piston engines, details of which follow.

Details of de Havilland gas-turbine engines will be found in Part I of this Section.

THE D.H. GIPSY QUEEN SERIES.

The Gipsy Queen Series 70 is the power unit of the D.H. Dove twin-engined light transport. The Gipsy Queen 30 Mark 2 is the power-plant of the de Havilland Heron four-engined feeder liner.

TYPE.—Six-cylinder in-line inverted air-cooled direct-drive (Series 30) or geared and supercharged (Series 70).

CYLINDERS.—Bore 4.725 in. (120 mm.). Stroke 5.905 in. (150 mm.). Swept volume 622 cub. in. (10.178 litres). Compression ratio 6.5 : 1. Barrels machined all over from carbon steel forgings. Working portion of bore hard-chromed. Aluminium-alloy heads clamped to barrels and crankcase by long steel studs.

PISTONS.—Fully-skirted, machined from light alloy forgings with two compression and one scraper rings. Fully floating gudgeon-pin located by external circlips and washers.

CONNECTING RODS.—I-section nickel-chrome steel forgings. Split big-ends with thin-wall linings. Small-ends have lead-bronze bushes.

CRANKSHAFT.—Six-throw shaft is a nickel-chrome forging machined all over and statically and dynamically balanced. Shaft runs on eight plain main bearings in case of Queen 30 and seven in case of Queen 70.

REDUCTION GEAR (Series 70).—Epicyclic gear driven off crankshaft through non-lined spring coupling. Gear ratio 0.711 : 1.

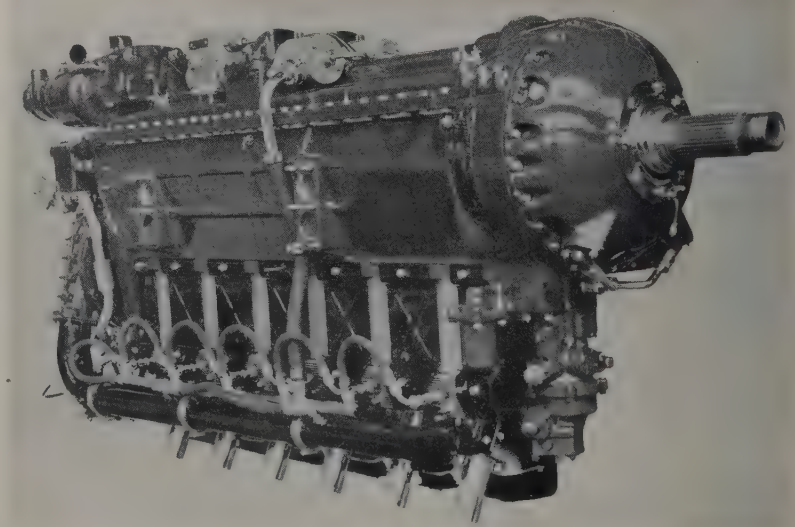
CRANKCASE (Series 70).—Aluminium-alloy main case stiffened by cross webs which carry the main and camshaft bearings, and additionally strengthened by two cross bolts. Rear wall extends below level of cylinder mounting face to form sump. Top cover is magnesium-alloy casting and carries magnetos, distributors, vacuum pump, generator, air compressor (hydraulic pump alternative) and their drives.

CRANKCASE (Series 30).—Basically similar to that of Queen 70, but is of magnesium-alloy.

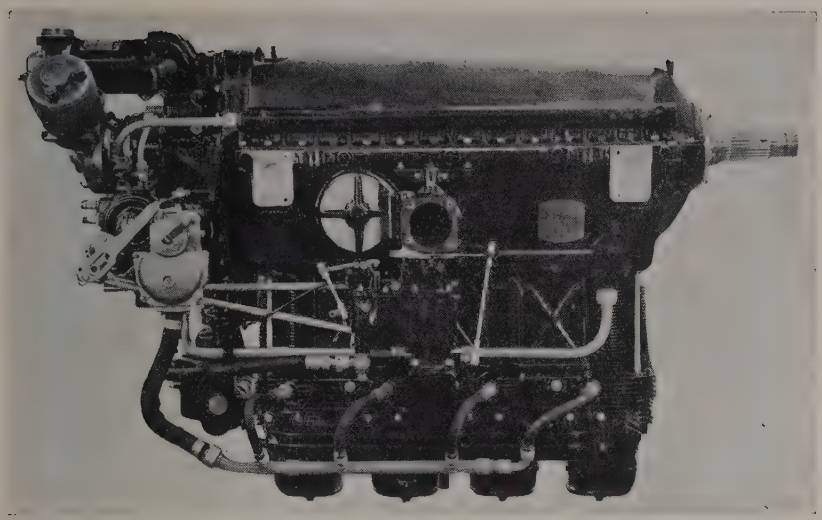
VALVE GEAR.—Fully enclosed. One inlet and one sodium-cooled exhaust valve per cylinder. Camshaft driven by spur gears from front end of crankshaft. Both inlet and exhaust valve stems tipped with Stellite and head of exhaust valve and valve seat coated with C.26.

INDUCTION (Series 30).—Pair of single-choke Hobson type A.I.55E/1 downdraught carburettors, each feeding three cylinders through separate three-branch manifolds. Air intake incorporates hot and cold air intake shutter and flame-trap.

INDUCTION (Series 70).—Hobson type DHG/1



The 380 h.p. de Havilland Gipsy Queen Series 70 Mk. 2 engine.



The 145 h.p. de Havilland Gipsy Major 10 Mk. 2 engine.

fuel-injection unit metering fuel through injection nozzle into eye of supercharger impeller.

SUPERCHARGER (Series 70). Centrifugal type driven through two gear trains and a spring quillshaft which is co-axial with and passes through hollow camshaft. Gear ratio 11.22 : 1.

IGNITION.—Two screened B.T.H. type CGD magnetos and B.T.H. distributors mounted on crankcase top cover and gear-driven from an auxiliary drive shaft at 1½ and ½ times engine speed respectively. Two sparking plugs per cylinder. Fixed ignition.

LUBRICATION.—Dry sump system. One pressure and two scavenge pumps with fabric-type pressure filter. Main bearings, big end and most bearings fed with oil under pressure. Pistons and cylinder walls sprayed with oil by jets from big-ends supplemented by oil mist; other moving parts by oil mist or splash. Valves and rocker gear operate in oil baths. Provision for Worth oil dilution system.

ACCESSORIES.—All accessories driven off rear of auxiliary drive shaft. Electric starter complete with hand turning gear or feathering pump is provided. Accessories include vacuum pump, generator up to 1,500 watts, and provision can be made for compressor or hydraulic pump.

COOLING.—Scoops are fitted to the port side of the engine. Air is directed between the cylinders and heads and suitably deflected by special baffles on starboard side of engine.

AIRSCREW (Queen 70).—Either (*a*) de Havilland bracket constant-speed type airscrew or (*b*) de Havilland hydromatic constant-speed feathering and braking airscrew, or other approved constant-speed airscrew.

AIRSCREW (Queen 30).—(*a*) or (*b*) as above. In addition (*c*) any approved type of fixed-pitch airscrew, either metal or wood.

DIMENSIONS, WEIGHTS AND PERFORMANCE.—See Table.

THE DE HAVILLAND GIPSY MAJOR 10 Mk. 2.

TYPE.—Four-cylinder in-line inverted air-cooled, direct-drive.

CYLINDERS.—Bore 4.646 in. (118 mm.). Stroke 5.512 in. (140 mm.). Swept volume 373.6 cub. in. (6.124 litres). Compression ratio 6 : 1. Barrels machined all over from forgings of carbon steel. Detachable heads of aluminium-alloy held by long H.T. steel studs to crankcase. Copper-asbestos gasket between cylinder barrel and head to ensure gastight joint.

PISTONS.—Slipper type machined from aluminium-alloy forgings. Fully-floating gudgeon-pin located by external circlips and washers. One scraper and two compression rings below gudgeon-pin.

CONNECTING RODS.—Machined all over from light-alloy stampings with split big-ends clamped together by four bolts and nuts. Big-end bearing of steel-backed white-metal-lined type. Small-end bearings unbushed.

CRANKSHAFT.—Machined all over from nickel-chromium-alloy steel forgings. Statically and dynamically balanced. Five steel-backed thin-wall Vandervell type main bearings. Ball-bearing to take thrust at front end. Journals and pins bored for lightness and lubrication.

CRANKCASE.—Aluminium-alloy casting. Lower half carries the five main crankshaft bearings, which are held in position by separate caps. Top cover is of magnesium-alloy stoutly ribbed to resist deflection.

VALVE GEAR.—Fully enclosed. One inlet and one exhaust valve to each cylinder. Sodium-cooled exhaust valves are used in the Series 10 Mk. 2 and Series 8. Operation by steel rockers, tubular steel push-rods, and steel tappets off camshaft running in five bearings on port side of engine. The camshaft is driven by spur-gears from rear end of crankshaft.

INDUCTION.—Claudel-Hobson AI.48 down-draught carburettor. Two position independent control change-over flap enables warm air to be selected by pilot under icing conditions. Altitude control is provided by an air valve in carburettor, operated from cockpit. Twin D.H. A.C. fuel pumps complete with hand-priming levers and remote controls for carburettor flooder fitted to port side of the crankcase and driven by cams from camshaft.

IGNITION.—Two B.T.H. magnetos mounted in inverted position on either side of rear cover. Impulse starter coupling on starboard magneto. Ignition equipment can be supplied screened or unscreened as required.

LUBRICATION.—Dry sump system. Engine-driven gear-type pump delivers at a pressure of 40 to 45 lb. per sq. in. (2.81 to 3.16 kg./cm.²) to an Auto Klean filter. Crankshaft, connecting-rods, camshaft and timing gear are pressure-fed from the main oilway. Cylinders lubricated by splash from connecting rod big-ends. Secondary external oil pipe lubricates all accessory drives and bearings on rear cover above crankshaft gear. Remaining gears and bearings in lower part of cover lubricated by splash oil from magneto gears and leakage past idler gear bushes which receive pressure oil from rear main bearings. Valve rocker gear lubricated separately by splash from rocker covers which are filled with oil to prescribed level.

ACCESSORIES.—The following accessories are driven from rear of crankshaft:—Vacuum pump, generator up to 500 watts, and there is provision for an electric or cartridge starter driving through a 12-jaw dog.

COOLING.—Same as for Gipsy Queen.

AIRSCREW DRIVE.—Direct. Left-hand tractor. Provision for fixed-pitch wood or metal airscrew of approved design or manually-operated variable-pitch airscrew, on No. 1 SBAC parallel-splined shaft.

DIMENSIONS, WEIGHTS AND PERFORMANCE.—See Table.

THE DE HAVILLAND GIPSY MAJOR 200.

The Gipsy Major 200, which is suitable for both fixed and rotary wing application, makes use of Gipsy Queen 30/70 Series cylinder heads and barrels, has an entirely new crankcase and accessory layout, and is fitted with S.U. fuel injection.

TYPE.—Four-cylinder in-line inverted air-cooled.

CYLINDERS.—Bore 4.725 in. (120 mm.). Stroke 5.905 in. (150 mm.). Swept volume 416 cub. in. (6.79 litres). Compression ratio 7.25 : 1. Same as for Gipsy Queen Series.

PISTONS, CONNECTING RODS AND VALVE GEAR.—As for Gipsy Queen Series.

CRANKSHAFT.—Four-throw shaft machined all over from nickel-chrome steel forging. Steel-nitrided. Five thin-wall steel-backed lead-bronze-lined bearings.

CRANKCASE.—Magnesium-alloy, stiffened by cross-webs and cross-bolted.

INDUCTION.—S.U. direct fuel injection into inlet ports.

IGNITION.—Two B.T.H. Type SG4 magnetos, with impulse starter on each, mounted on wheelcase. Two K.L.G. KA1 or RC5/4H sparking-plugs per cylinder. Tecalemit ignition harness.

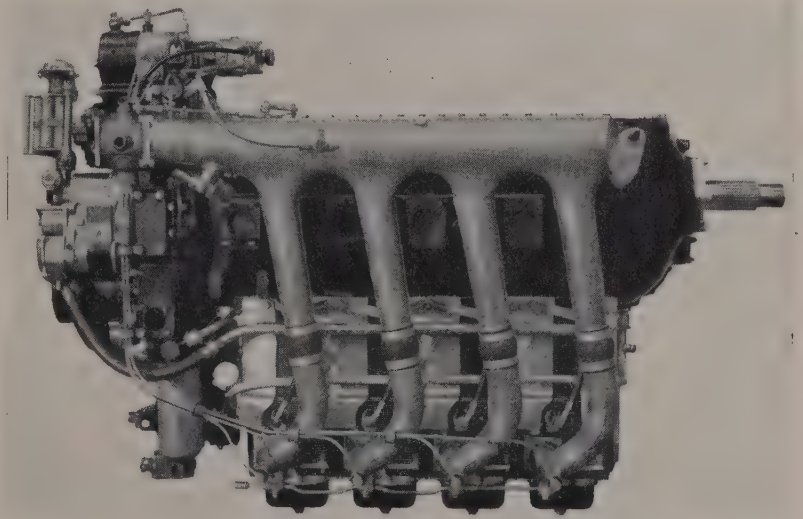
LUBRICATION.—Dry sump system. One pressure, two scavenge pumps.

AIRSCREW DRIVE OR DRIVE FOR HELICOPTER PRIMARY GEAR-BOX.—Direct. Direction counter clockwise seen from rear. S.B.A.C. No. 1 airscrew shaft.

ACCESSORIES.—Engine accessories include S.U. fuel injector pump (1 : 1 gear ratio), Plessey F.1 Mk. 3M fuel pump (0.75 : 1 gear ratio), and Smiths 122-RV/SP engine speed indicator and generator (1 : 1 gear ratio). Aircraft accessories include Hymatic SH6/7C air compressor or, alternatively, Lockheed hydraulic pump (gear ratio 0.548 : 1), Plessey B. 3X/Mk. 2 vacuum pump (1.27 : 1 gear ratio), and Rotax B.2001-2F generator (2.55 : 1 gear ratio).

STARTING.—Plessey S3 Mk. 3 cartridge (helicopter and fixed-wing installation) or B.T.H. electric (fixed-wing).

DIMENSIONS, WEIGHTS AND PERFORMANCE.—See Table.



The 200 h.p. de Havilland Gipsy Major 200 engine.

THE DE HAVILLAND GIPSY MAJOR 215.

Developed from the Gipsy Major 200, this engine incorporates a number of refinements and will be available in due course with an exhaust-driven turbo-supercharger which will enable the full-throttle power of 215 h.p. to be maintained up to 4,000 ft. (1,220 m.) and ICAN + 30°C. Until this supercharger is ready for installation, water-methanol injection equipment is being fitted as a temporary measure. A governer control is fitted to limit the maximum r.p.m. when the engine is running with the main rotor de-clutched to avoid the possibility of an engine over-speed.

The Gipsy Major 215 powers the Saunders-Roe Skeeter light helicopter, under the military designation of Gipsy Major Mk. 140.

TYPE.—Four-cylinder in-line inverted air-cooled.

CYLINDERS.—As for Gipsy Major 200, except that the aluminium-alloy head is secured to the barrel by eight studs located in the head, and the barrel secured to the crankcase by a base flange and eight short studs located in the crankcase lower face.

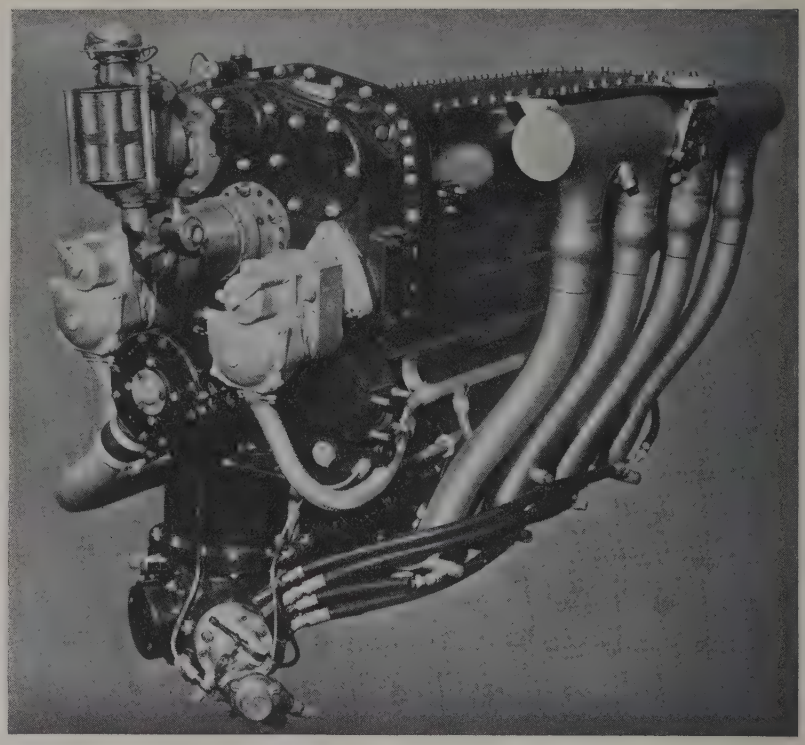
PISTONS, CONNECTING RODS and CRANKSHAFT.—As for Gipsy Major 200.

CRANKCASE.—As for Gipsy Major 200. Top cover plate in aluminium-alloy, acid-etched for lightness.

VALVE GEAR.—One "tulip" pattern high-chromium steel inlet valve and one hollow, sodium-cooled, stellite-tipped exhaust valve per cylinder. Firth NMC valve seats. Inlet valve seats peened, exhaust valve seats screwed into cylinder heads. Camshaft as for Gipsy Major 200.

INDUCTION.—S.U. direct fuel injection into ports. Pump at bottom of main wheelcase, drive being taken through oil pump.

SUPERCHARGER (when fitted).—Exhaust-driven turbo-supercharger.



The 215 h.p. de Havilland Gipsy Major 215 engine.

IGNITION, LUBRICATION AND AIRSCREW DRIVE.—As for Gipsy Major 200.

ACCESSORIES.—As for Gipsy Major 200, except that fuel pump is Plessey F.1 Mk. 14. Methanol-water injection optional.

STARTING. As for Gipsy Major 200.

MOUNTING.—Four bearer pads, one at each corner of crankcase.

DIMENSIONS, WEIGHTS AND PERFORMANCE.—See Table.

THE DE HAVILLAND GIPSY QUEEN AND GIPSY MAJOR ENGINES.

Engine Type	Gipsy Queen 30 Mk. 2	Gipsy Queen 70-4	Gipsy Queen 70 Mk. 2	Gipsy Major 10 Mk. 2	Gipsy Major 200	Gipsy Major 215
Take-off Power	240-250 h.p. at 2,500 r.p.m. at sea level Fuel consumption 18.75-19.5 gals. (85.1-88.5 litres) per hr.	325-340 h.p. at 2,800 r.p.m. at sea level Fuel consumption 32.75 gals. (147.3 litres) per hr.	365-380 h.p. at 3,000 r.p.m. at sea level Fuel consumption 36.5-38 gals. (161.3-168 litres) per hr.	139-145 h.p. at 2,550 r.p.m. at sea level Fuel consumption 11.0-11.5 gals. (50-52.2 litres) per hr.	192-200 h.p. at 2,600 r.p.m. at sea level Fuel consumption 14.4-15 gals. (65.4-86.2 litres) per hr.	215 h.p. at 2,850 r.p.m. at sea level Fuel consumption 13.5-15 gals. (61.3-68.1 litres) per hr.
Maximum Continuous Power	240-250 h.p. at 2,500 r.p.m. at sea level Fuel consumption 18.75-19.5 gals. (84.3-87.7 litres) per hr.	316-330 h.p. at 2,600 r.p.m. at 5,000 ft. (1,525 m.) Fuel consumption 23.5-24.5 gals. (106.7-111.2 litres) per hr.	341-355 h.p. at 2,700 r.p.m. at 4,250 ft. (1,296 m.) Fuel consumption 31.6-32.9 gals. (142.2-148 litres) per hr.	136-142 h.p. at 2,400 r.p.m. at sea level Fuel consumption 10.75-11.25 gals. (48.3-50.6 litres) per hr.	186-194 h.p. at 2,500 r.p.m. at sea level Fuel consumption 13.9-14.4 gals. (63.2-65.6 litres) per hr.	207 h.p. at 2,700 r.p.m. at sea level Fuel consumption 13-14.5 gals. (59-65.8 litres) per hr.
Maximum Weak Mixture Power	206 h.p. at 2,500 r.p.m. at 2,900 ft. (884 m.) Fuel consumption 12.3-12.9 gals. (55.9-58.5 litres) per hr.	265 h.p. at 2,400 r.p.m. at 8,000 ft. (2,440 m.) Fuel consumption 17.5 gals. (79.5 litres) per hr.	265 h.p. at 2,400 r.p.m. at 8,000 ft. (2,440 m.) Fuel consumption 16.8-17.5 gals. (75.6-78.7 litres) per hr.	125 h.p. at 2,300 r.p.m. at 3,000 ft. (915 m.) Fuel consumption 8.85-9.0 gals. (39.8-40.5 litres) per hr.	160-167 h.p. at 2,500 r.p.m. at sea level Fuel consumption 9.2-9.6 gals. (41.6-43.5 litres) per hr.	174 h.p. at 2,650 r.p.m. at 3,000 ft. (915 m.) Fuel consumption 9.8-10.5 gals. (44.5-47.6 litres) per hr.
Weight dry (including cooling scoops, baffles and fuel-pump unit)	525 lb. (238.3 kg.) + 2½%	685 lb. (311 kg.) + 2½%	690 lb. (313 kg.) + 2½%	325 lb. (147.5 kg.) + 2½%	400 lb. ±5 lb. (181.4 kg. ±2.3 kg.)	400 lb. ±5 lb. (181.4 kg. ±2.3 kg)
Supercharger gear ratio	—	11.22 : 1	11.22 : 1	—	—	—
Airscrew gear ratio	—	0.811 : 1	0.711 : 1	—	—	—
Overall length (from centre-line of airscrew)	61.5 in. (1,562 mm.)	71.75 in. (1,822 mm.)	71.75 in. (1,822 mm.)	42.1 in. (1,070 mm.)	51 in. (1,295 mm.)	51 in. (1,295 mm.)
Overall width	19.59 in. (497.5 mm.)	19.56 in. (497 mm.)	19.56 in. (497 mm.)	20.1 in. (510 mm.)	16.8 in. (426 mm.)	16.8 in. (426 mm.)
Overall height	32.99 in. (838 mm.)	33.23 in. (844 mm.)	33.23 in. (844 mm.)	30.6 in. (777 mm.)	29.8 in. (758.5 mm.)	29.8 in. (758.5 mm.)
Fuel Grade	Min. Octane 91-96	Min. Octane 100-130	Min. Octane 100-130	Min. Octane 80	Min. Octane 100-130	Min. Octane 100-130

ROLLASON

ROLLASON AIRCRAFT AND ENGINES LTD.

HEAD OFFICE AND WORKS: CROYDON AERODROME, CROYDON, SURREY.

Directors: Norman Jones, Alan Sproxton, Mrs. W. M. Rollason.

Secretary: W. V. Fitzmaurice.

In support of its manufacture under licence of the Druine Turbulent light aeroplane, Rollason Aircraft and Engines Ltd. is undertaking the conversion of Ardem 4CO2 power plants for this aircraft, from standard motor car engines.

Full details of the Ardem 4CO2 are given in the French section of this work.

Rollason has also developed an engine designated the RTW, which is identical with the Ardem 4CO2 except that it has a direct-drive magneto shaft on the rear face instead of a chain-drive to a magneto mounted under the engine.

ROLLS-ROYCE

ROLLS-ROYCE, LTD.

HEAD OFFICE: DERBY.

AERO-ENGINE DIVISION WORKS: DERBY, GLASGOW, HUCKNALL AND BARNOLDSWICK.

LONDON OFFICE: 14-15, CONDUIT STREET, W.1.

Established: March 15, 1906.

Directors: Lord Kindersley, C.B.E., M.C. (Chairman); J. D. Pearson, J.P., B.Sc.(Eng.), Wh.Sc., M.I.Mech.E., A.F.R.Ae.S., M.I.P.E. (Chief Executive, Deputy Chairman and Managing Director, Aero-Engine Division); Whitney W. Straight, C.B.E., M.C., D.F.C. (Deputy Chairman); Harald Peake, M.A.; W. T. Gill, C.A. (Financial Director); Dr. F. Llewellyn Smith, M.Sc., D.Phil. (Managing Director, Motor Car Division); W. A. Robotham (Managing Director, Oil Engine Division); A. A. Rubbra, B.Sc. (Technical Director); A. F. Kelley, B.Sc. (General Manager, Aero-Engine Division).

Chief Engineer, Aero-Engine Division: A. A. Lombard, F.R.Ae.S.

Delivery of the last new Derby-built Rolls-Royce aircraft piston-engine, a Griffon for an Avro Shackleton of the South African Air Force, was made in December, 1955. Production of the Griffon has continued on a limited scale at Glasgow.

Rolls-Royce began aero-engine production in December, 1915, and built a total of 51,169 piston-engines at Derby alone in the following 40 years. A still larger number was built in the company's other factories.

Rolls-Royce piston-engines included many famous types, notably the Falcon and Eagle of the 1914-18 war; the Kestrel of the inter-war period; and the ubiquitous and versatile Merlin and the Griffon of the 1939-45 war.

Many great flights were made on Rolls-Royce piston-engines, including the first non-stop Atlantic crossing by Alcock and Brown in the Eagle-powered Vimy, the first flights from England to Australia, to India and to South Africa, and the first crossing of the South Atlantic by an Eagle-engined Fairey IIID seaplane. Specially developed Rolls-Royce "R" racing engines, boosted eventually to give the then-unprecedented power of 2,300 h.p., enabled Supermarine seaplanes to win the 1929 and 1931 contests for the Schneider Trophy, gaining the Trophy outright for Britain. The "R" provided invaluable experience for development of the later Merlin and Griffon.

More Merlin engines were built than any other type of British aero-engine, with wartime production by Packard in the United States supplementing home production. Very large numbers of Merlins and Griffons are still in civil and military service throughout the world, and Rolls-Royce will continue to manufacture spare parts for these and to undertake a certain amount of re-conditioning work.

Otherwise, Rolls-Royce aero-engine production capacity is now devoted exclusively to gas-turbines, and the company's current activities are described fully in the "Gas-turbines" Section of this work.

CZECHOSLOVAKIA

CESKOSLOVENSKE ZÁVODY LETECKÉ (Czechoslovak Aircraft Works).

HEAD OFFICE: PALACKÉHO NÁM 4, PRAGUE II.

Manager: Ladislav Hlavsa.

In this concern is grouped all the aviation industry, including the factories producing aero-engines and airscrews.

The sale of all the aviation products as well as the information service are handled exclusively by :—

OMNIPOL LTD., WASHINGTONOVA 11, PRAGUE III.

THE WALTER MINOR 4-III.

TYPE.—Four-cylinder inverted in-line air-cooled, ungeared.

CYLINDERS.—Bore 105 mm. (4.13 in.). Stroke 115 mm. (4.53 in.). Total capacity 3.98 litres (247.87 cub. in.). Compression ratio 6 : 1. Steel cylinders with cooling fins machined from solid. Cylinder bores nitrided. Detachable cylinder-heads are aluminium-alloy castings. Cylinder and head assembly attached to crankcase by four cylinder holding-down studs.

PISTONS.—Aluminium-alloy stampings. Three compression rings and one scraper ring. Gudgeon-pins secured by spring-circlips.

VALVE GEAR.—One inlet and one exhaust valve per cylinder, of special heat-resisting alloy steel with nitrided stems. Double valve springs. Valves operated by the camshaft through push-rods and rocker-arms. Rockers fitted with needle bearings, with rollers for the valves and valve-clearance adjusting-screws at the push-rod ends. Valve and rocker mechanism on each cylinder enclosed in Elektron cover.

CONNECTING RODS.—H-section, stamped from aluminium-alloy, polished. Split big-ends provided with steel-backed lead-bronze bearings.

CRANKSHAFT.—Forged from special chrome-vanadium steel, machined all over. Crank-pins and journals nitrided. Carried in five steel-backed lead-bronze bearings and a ball thrust-bearing at the front end.

CRANKCASE.—Heat-treated magnesium-alloy casting.

LUBRICATION.—Dry-sump pressure lubrication. Double gear-type oil-pump with pressure and scavenge stages located at the rear of the crankcase above the sump. Oil drawn from oil tank by pressure pump, provided with an inlet and a pressure relief valve. Spent oil in sump withdrawn by scavenge pump and returned to oil tank. Union in the pressure line on the crankcase is adapted for pressure-gauge connection. The valve-gear works in an oil bath in each rocker cover box. The lubrication system can be modified on request for aerobatic flying, mainly by the addition of an automatic valve to the scavenge line.

INDUCTION SYSTEM.—Walter 45-I or 45-AK (aerobatic) down-draught carburettor with manual mixture control, acceleration pump, special jet for inverted flight and choke. Cast induction manifold, pre-heated by exhaust gases, fitted with four priming jets and with 4 drain valves. A hot and cold air intake controllable from the cockpit, fitted on special request. Cold air passes directly to the carburettor, warm air is drawn from the cylinders through a flame trap. Fuel supplied to the carburettor by double diaphragm Walter 2M 50 fuel-pump fitted with a pressure-gauge connection.

IGNITION.—Dual shielded ignition; non-shielded ignition optional. Two Scintilla Vertex magnetos OAF 4R 402 Z170 (port) and OAF 4R 602 Z170 (starboard) with automatic sparking advance. Magnetos placed side-by-side in a hanging position at the rear of the crankcase. Starboard magneto provided with impulse unit. Sparking plugs 12×1.25 mm. (PAL 12R 250).

COOLING.—Air scoop with an easily removable sliding inspection strip for access to the sparking plugs fitted on port side, with cylinder baffles on starboard side.

STARTING.—Electric and hand starter with crank, type Walter RE 25, or electric starter Walter P320, both supplied on request.

ACCESSORY DRIVES AND EQUIPMENT.—On the rear end of the crankcase; left-hand a tachometer drive (D. of R. clockwise, 1/2 engine speed); right-hand a fuel-pump mounting-flange and drive (D. of R. clockwise, 1/2 engine speed). On the port side of the crankcase can be fitted either a directly-driven 24-volt 300 watt. or 24-volt 600 watt. generator.

MOUNTING.—Four engine bearer feet with rubber vibration dampers, supplied on special request.

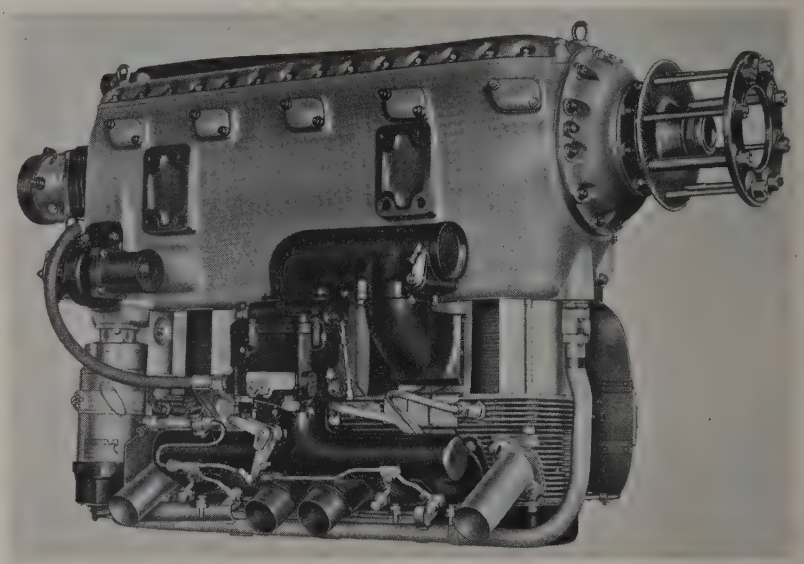
AIRSCREW DRIVE.—Direct, left-hand tractor (when looking at the engine from the rear). Boss for wooden fixed-pitch airscrew is normally used. Keyed to the tapered crankshaft front-end and retained by a nut. Airscrew hub attached to boss by retaining plate and eight retaining bolts. Two-blade Type V-405 or V-406 metal four-position variable-pitch airscrew, or Walter V401 mechanically-operated or Walter V401E electrically-operated variable-pitch airscrew.

DIMENSIONS.—
Overall length with airscrew boss 1,032 mm. (40.63 in.).
Overall width without bearer feet 399 mm. (15.7 in.).
Overall height 632 mm. (24.9 in.).

WEIGHT DRY (including normal accessories).—90.3 kg. (199 lb.).

PERFORMANCE.—
Rated output at sea level 105 b.h.p. at 2,500 r.p.m.
Cruising output 80 b.h.p. at 2,300 r.p.m.

CONSUMPTIONS.—
Fuel consumption at rated sea level power 245 gr. (.54 lb.) per h.p./hr.
Fuel consumption at cruising power 225 gr. (.49 lb.) per h.p./hr.
Oil consumption 2-8 gr. (.0044-.018 lb.) per h.p./hr.



The 105 h.p. Walter Minor 4-III four-cylinder inverted air-cooled engine.

THE WALTER MINOR Sc. (M 332).

TYPE.—Four-cylinder inverted in-line air-cooled, ungeared, supercharged.

CYLINDERS.—Basically similar to those of Minor 4-III. Conpression ratio 6.3 : 1. Valve seats of special steel. Valve guides and sparking plug bushes of bronze.

PISTONS.—Aluminium-alloy stampings with graphited surfaces. Two compression rings and one split scraper ring. Gudgeon-pins secured by spring-circlips.

CONNECTING RODS—H-section aluminium-alloy forgings. Two split big-ends bolted together by two bolts. Steel two-piece liner lead-bronze plated.

CRANKSHAFT.—Forged from special chrome-vanadium steel, machined all over. Nitrided crank-pins. Carried in five steel-backed lead-bronze plated slide bearings which are lightly lead-lined, and in one ball-thrust bearing at the front. Terminating in a wedge-shape cone for the propeller hub mounting.

CRANKCASE.—Heat-treated magnesium alloy (elekton) casting, with top and front covers. Deep-sunk bearing covers forged from aluminium alloy.

VALVE GEAR.—Camshaft on the cylinder heads actuates the valves by means of rocker arms. Camshaft driven by vertical shaft and bevel gears. One inlet valve of heat-treated steel, one exhaust valve of austenitic steel with stellite seat. Nitrided valve stems.

IGNITION.—Shielded type. Two Scintilla-Vertex Type OBF 4R magnetos with automatic sparking advance. Magnetos placed vertically, driven by bevel gears provided with gear moment dampers. Two Jiskra II/51A sparking plugs per cylinder 12×1.25 mm. (0.5×.07 in.).

LUBRICATION.—Dry sump pressure-feed type. Double gear-type oil-pump with pressure and scavenge stages mounted on rear wall of crankcase. Oil from tank passes through triple filter into pressure stage of oil-pump and then into main channel drilled in crankcase. Pressure control valve adjusted to 3.5-4 atm. Inlet union of main channel provided with oil-pressure gauge connecting pipe. Oil returned from sump by scavenge stage of oil-pump to tank. Special gear-type oil-pump draws oil from cam box and forces it into crankcase from where it flows into sump.

SUPERCHARGER.—Centrifugal type mounted on engine rear flange. Driven through a damping rubber coupling from crankshaft. Planetary gear, ratio 7.4 : 1, engaged via band friction clutch. Force feed lubrication of supercharger from main engine lubrication system.

FUEL SYSTEM.—Low-pressure injection system. Fuel pump driven from camshaft. Fuel injection nozzles located in front of intake valves. Automatic control in relation to engine manifold pressure. Fuel supplied to injection pump by fuel pressure pump located in common body with injection pump.

FUEL GRADE.—Minimum 72 octane.

COOLING.—Air scoop on port side, designed to provide easy access to sparking plugs and easy removal of scoop and baffles.

STARTING.—Electric starter combined with supercharger. Electric motor rotates the starter dog which is engaged by an electro-magnet. Gears and clutch of supercharger serve the starter also.

ACCESSORIES.—One 300 or 600 watt 24v. dynamo. Electric r.p.m. transmitter, drive 1 : 1. Airscrew control unit. Mechanical tachometer on oil pump, drive 1 : 2.

MOUNTING.—Four engine-bearer feet with rubber dampers.

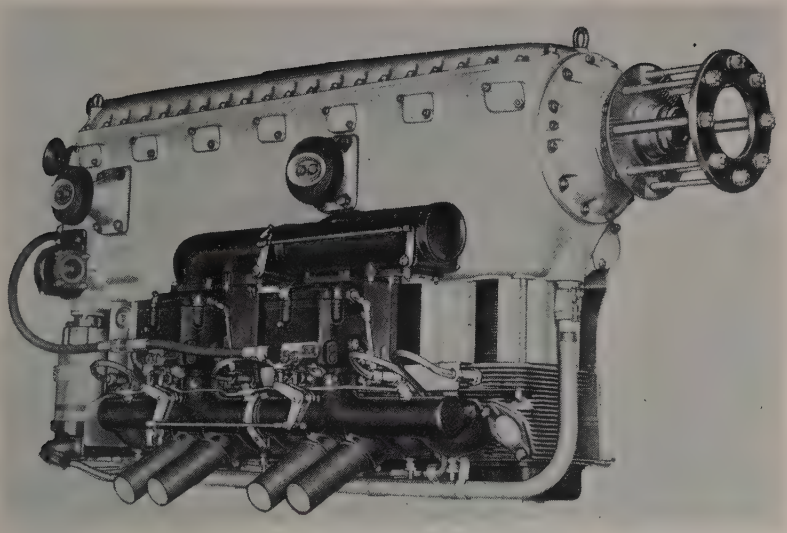
AIRSCREW DRIVE.—Direct left-hand tractor.

DIMENSIONS.—
Length (including supercharger and starter, but less propeller boss) 1,102 mm. (43.4 in.).
Height 628 mm. (24.7 in.).
Width (with dynamo and electric tachometer) 425 mm. (16.7 in.).

WEIGHTS.—
Dry (with ignition harness, supercharger and starter) 102 kg. (225 lb.).

PERFORMANCE.—
Take-off power 140 h.p. at 2,700 r.p.m.
Rated power 115 h.p. at 2,550 r.p.m.
Cruising power 100 h.p. at 2,400 r.p.m.

CONSUMPTIONS.—
Fuel at take-off power 0.26 kg. (0.57 lb.) per h.p./hr.
Fuel at rated power 0.215 kg. (0.475 lb.) per h.p./hr.
Fuel at cruising power 0.205 kg. (0.45 lb.) per h.p./hr.
Oil 0.2 kg./hr. (0.44 lb./hr.).



The 160 h.p. Walter Minor 6-III six-cylinder inverted air-cooled engine.

THE WALTER MINOR M-337.

The M-337 is a development of the Minor 6-III with fuel injection. It gives some 200 h.p. and will be fitted in later models of the Morava L-200 five-seat light aircraft.

THE WALTER MINOR 6-III.

TYPE.—Six-cylinder inverted in-line air-cooled, ungeared.

CYLINDERS.—Same as for Minor 4-III. Total capacity 5.97 litres (364.31 cub. in.).

PISTONS AND CONNECTING RODS.—Same as for Minor 4-III.

CRANKSHAFT.—Six-throw crankshaft, forged from special nitrided chrome-vanadium steel and machined all over. Carried in seven two-piece steel-backed lead-bronze bearings and one ball thrust bearing at the front end.

CRANKCASE.—Assembly consists of crankcase itself, upper and front covers. Crankcase has double cross-webs in which crankshaft and camshaft bearings are mounted. All crankcase parts cast from heat-treated magnesium alloy.

VALVE GEAR.—Two parallel interchangeable valves in each cylinder, made from high duty special steel. Valve stems are nitrided. Steel valve seats pressed into the cylinder head. Camshaft on port side of crankcase, driven from crankshaft through a spur gear.

INDUCTION.—Two Walter W45 or W45-AK (aerobatic) down-draught carburettors with manual mixture control and acceleration pump.

FUEL.—72 octane minimum.

IGNITION.—Dual shielded ignition. Two Scintilla magnetos OAF 6R 402 Z171 (port) and OAF 6R 602 Z171 (starboard) with automatic sparking advance. Magnetos placed in a hanging position at rear of crankcase. Port magneto driven from camshaft, starboard magneto driven from fuel pump drive. Starboard magneto provided with impulse unit. Sparking plugs 12 × 1.25 mm. (PAL 12P/250 SE).

LUBRICATION AND AIRSCREW DRIVE.—Same as for Minor 4-III.

ACCESSORIES.—Type 2M-50 fuel pump (starboard side of crankcase), Scintilla 24-volt 300-watt generator (port side) and tachometer generator (starboard side) driven by train of spur gears. Tachometer driven by flexible shaft.

STARTING.—Walter type R 25 hand starter, type RE 25 hand and electric starter, or type P320 electric starter.

MOUNTING.—Two engine bearer feet on each side of crankcase, with rubber vibration dampers.

DIMENSIONS.—
- Overall length without airscrew hub 1,250 mm. (49.21 in.).
- Overall width without bearer feet 445 mm. (17.49 in.).
- Overall height 639 mm. (25.16 in.).

WEIGHT DRY (including normal accessories).—126.8 kg. (279.5 lb.) ± 2%.

PERFORMANCE.—
- Rated output at S/L. 160 h.p. at 2,500 r.p.m.
- Cruising power 125 h.p. at 2,300 r.p.m.

CONSUMPTIONS.—
- Fuel consumption at rated S/L. power 245 gr. (.54 lb.) per h.p./hr.
- Fuel consumption at cruising power 225 gr. (.49 lb.) per h.p./hr.
- Oil consumption at rated S/L. power 2-8 gr. (.0044-.018 lb.) per h.p./hr.

THE PRAGA DORIS B.

TYPE.—Six-cylinder horizontally-opposed air-cooled, geared.

CYLINDERS.—Bore 115 mm. (4.53 in.). Stroke 115 mm. (4.53 in.). Total capacity 7.167 litres (437.36 cub. in.). Compression ratio 7 : 1. Chrome-nickel steel cylinders with cooling fins and two flanges. One flange for mounting cylinder on crankcase; the other provides a seating for the head which is cast from special heat-treated aluminium alloy and bolted to the cylinder.

PISTONS.—Drop forged from aluminium alloy. Two compression rings and one double scraper ring. Hollow steel gudgeon-pins.

CONNECTING RODS.—H-section, drop forged from case-hardened steel and polished all over. Split big-ends with case-hardened bearing surface. Bronze bush pressed into little-end to provide mounting for gudgeon-pin.

CRANKSHAFT.—Six-throw crankshaft, forged from high-duty chrome-vanadium steel, machined and polished all over. Carried at each end in roller bearings and in two centre anti-friction bearings. Front end with reduction gear drive carried in lead-bronze bearing.

CRANKCASE.—Two-piece crankcase cast from heat-treated magnesium alloy. Housings for main bearings mounted in cross-webs.

VALVE GEAR.—Two inclined valves per cylinder. Inlet valves made from chrome-vanadium steel: hollow exhaust valves from chrome-tungsten steel with sodium filling. Valve seats and stem face ends are stellited. Chrome-mangan-nickel steel valve seats pressed into cylinder head. Two camshafts driven by bevel gearing from crankshaft.

INDUCTION.—Type P-110 vertical float carburettor with manual mixture control and damper.

FUEL.—67-80 octane.

IGNITION.—Two Scintilla OBF 6R 502 Z162 magnetos with automatic ignition advance. Magnetos side-by-side in hanging position on upper part of crankcase and driven through spur gears. Two type PAL L23.84 screened spark-plugs per cylinder. Dual shielded harness.

LUBRICATION.—Dry sump pressure lubrication with oil tank on engine. Gear-type oil pump with one pressure and three scavenge stages.

AIRSCREW DRIVE.—Planetary type reduction gear. Ratio 1 : 0.55172. Right-hand tractor (when looking at engine from rear). Airscrew shaft of chrome-nickel-vanadium steel with SAE 41 B-N-30 standard spline.

ACCESSORIES.—Type P245 fuel pump. Type PAL 09-9095.20 generator. Two tachometer drives.

STARTING.—Type P304 electric starter, with hand crank.

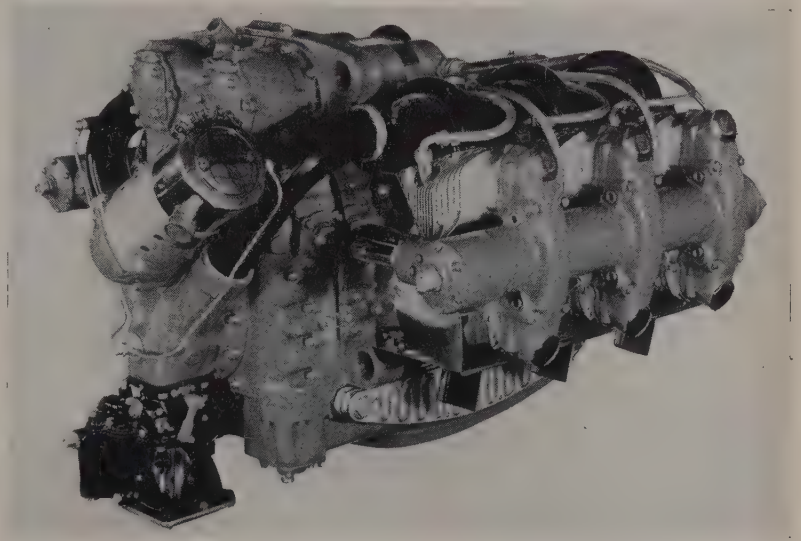
MOUNTING.—Four-point suspension with rubber vibration dampers.

DIMENSIONS.—
- Overall length 1,229 mm. (48.38 in.).
- Overall width 934 mm. (36.81 in.).
- Overall height 611 mm. (24.06 in.).

WEIGHT DRY (without accessories, ignition harness or mounting feet).—198 kg. (436 lb.). ± 2%.

PERFORMANCE.—
- Rated power 200 h.p. at 2,900 engine r.p.m.
- Take-off power 220 h.p. at 3,000 engine r.p.m.
- Cruising power 180 h.p. at 2,800 engine r.p.m.

CONSUMPTIONS.—
- Fuel consumption at rated power 230 ± 10 gr. (.507 lb.) per h.p./hr.
- Fuel consumption at take-off power 240 ± 10 gr. (.529 lb.) per h.p./hr.
- Fuel consumption at cruising power 210 ± 5 gr. (.463 lb.) per h.p./hr.
- Oil consumption 3-6 gr. (.0066-.013 lb.) per h.p./hr.



The 220 h.p. Praga Doris B flat-six air-cooled engine.

FRANCE

DRUINE

AVIONS ROGER DRUINE.

ADDRESS : 20, AVENUE DU GÉNÉRAL CLAVERY, PARIS (16e).

The late M. Roger Druine developed a light aero-engine from the standard Volkswagen motor car engine. Known as the Ardem 4 CO2, it is particularly suitable for powering the Druine Turbulent single-seat light aircraft and is being built also in Britain by Rollason Aircraft and Engines Ltd. of Croydon Airport, Surrey.

THE ARDEM 4 CO2.

TYPE.—Four-cylinder horizontally-opposed air-cooled.

CYLINDERS.—Bore 77 mm. (3.031 in.). Stroke 64 mm. (2.52 in.). Capacity 1,192 cc. (72.62 cub. in.). Compression ratio 6.6 : 1.

PISTONS.—Light metal, with steel reinforcement. Two compression and one oil ring.

CRANKSHAFT.—One-piece forging, running in four bearings.

CRANKCASE.—Light alloy chill mould casting.

INDUCTION SYSTEM.—Solex P.B.1C 32 carburettor, to which fuel is supplied by a Peugeot S.E.V. 46C fuel pump.

FUEL GRADE.—80 octane or good grade motor spirit.

IGNITION.—Dual ignition from R.B. magneto. Two Champion L.10S or Bosch W.225T1 14 mm. plugs per cylinder.

WEIGHT.—
Complete with exhaust stubs, airscrew and accessories 60.3 kg. (133 lb.).

PERFORMANCE.—
Take-off output 30.7 h.p. at 3,000 r.p.m.

CONSUMPTION.
8.5 litres (15 Imp. pints) per hr.

POTEZ

SOCIÉTÉ DES AVIONS ET MOTEURS HENRY POTEZ.

HEAD OFFICE : 46, AVENUE KLÉBER, PARIS (XVIe).

DESIGN AND PRODUCTION WORKS : 206 RUE HENRI-BARBUSSE, ARGENTEUIL (SEINE-ET-OISE).

Based on the designs and development work of its long-established Engine Design Laboratory (L.E.M.), the Société des Moteurs Henry Potez is producing aircraft piston engines with new facilities at Argenteuil, in north-west Paris.

Potez is concentrating on the development and production of a range of four, six, and eight cylinder engines. All engines use the same basic cylinder of 125 mm. × 120 mm. (4.92 in. × 4.72 in.) and all have been type-tested and extensively flight-tested. Direct injection was introduced with Type 6-D 30 and density-tachometric carburation with the 4-D 30. Engines of the basic 6-D type are now cleared officially for 1,200 hours' operation between major overhauls.

Potez is also engaged on sub-contract work, including the manufacture of transmission components for Turbomeca Artouste turbines, of which 325 sets had been delivered by the end of January, 1958, for use in Sud-Aviation Alouette helicopters.

THE POTEZ 4-D 00.

TYPE.—Four-cylinder in-line inverted, air-cooled.

CYLINDERS.—Bore 125 mm. (4.92 in.). Stroke 120 mm. (4.72 in.). Swept volume 5.85 litres (352 cub. in.). Compression ratio 7 : 1. Nitrided steel cylinder barrel with Y-alloy die-cast cylinder heads secured by four long bolts screwing into crankcase.

PISTONS.—Y-alloy die forging. Two compression and one double scraper rings above gudgeon-pin, one scraper ring below. Floating gudgeon-pin.

CONNECTING RODS.—I-section aluminium-alloy forgings with split big-ends and split steel-backed lead-bronze lead-plated bearing. Assembly by four chrome-nickel steel bolts. Little-end floating directly on gudgeon-pin.

CRANKSHAFT.—Nickel-chrome-molybdenum steel, forged and machined. Four-throw, on five bearings. Deep-groove ball-thrust bearing at front, remainder are steel-backed lead-bronze lead-lined. Solid 60 mm. (2.36 in.) 16-splined airscrew shaft.

CRANKCASE.—Aluminium silicon-alloy casting with duralumin top cover. Five duralumin forged bearing caps secured by chrome-nickel steel studs. Chrome-nickel steel through-bolts at centre bearing cap. Cast magnesium-alloy oil sump in rear section of case.

VALVE GEAR.—Two symmetrically-inclined valves of nitrided austenitic steel per cylinder. Stellited sodium-cooled exhaust valves. Tin-silicon-cupronickel shrunk-in valve-seats. Single camshaft in crankcase operates all valves through roller tappets, push-rods and adjustable rocker-arms. Two shot-peened vanadium steel valve springs per cylinder.

INDUCTION.—One Zenith downdraught Type 601 DC carburettor with automatic altitude control. Exhaust-heated muff on induction pipe. Pressure feed by one A.M. pump type CM12.

FUEL.—80 octane minimum. Up to 1.2 cc.'s of lead per litre accepted by engine.

IGNITION.—One double RB type J4C magneto. Screened harness and two 14 mm. spark-plugs per cylinder.

LUBRICATION.—Dry sump type. One pressure and two scavenge pumps, fore and aft. Normal oil pressure 3.5-5.0 kg./cm.² (49.7-71.0 lb./sq. in.). Oil temperature : min. 45°C. ; max. 95°C. at inlet, 100°C. at outlet. Provision for scavenging of crankcase in inverted flight by gravity-sensitive dual valve.

AIRSCREW DRIVE.—Direct left-hand drive. Splines conforming to B.N.Aé. 212.01. Provision for hydraulic variable-pitch airscrew.

ACCESSORIES.—Drive for 24-volt 1,600-watt electric generator on right rear side of crankcase. Ratio 2.48 : 1. Tachometer drive on rear of crankcase. Ratio 1 : 2. Vacuum pump and hydraulic pump drives on rear of sump case. Ratios 1.06 : 1 and 0.67 : 1 respectively. Drive at front of crankcase for hydraulic regulator for constant speed airscrew.

STARTER.—Potez electric 24-volt direct-drive starter.

MOUNTINGS.—Four-point flexible mountings, two on each side of crankcase.

COOLING.—Three inter-cylinder deflectors, one rear deflector, and one side chute in two pieces, one movable. Maximum temperatures (at 2,400 r.p.m.) 250°C. cylinder heads, 140°C. cylinder barrels.

DIMENSIONS.—
Overall length 1,220 mm. (48.0 in.).
Overall height 720 mm. (28.35 in.).
Overall width 530 mm. (20.87 in.).

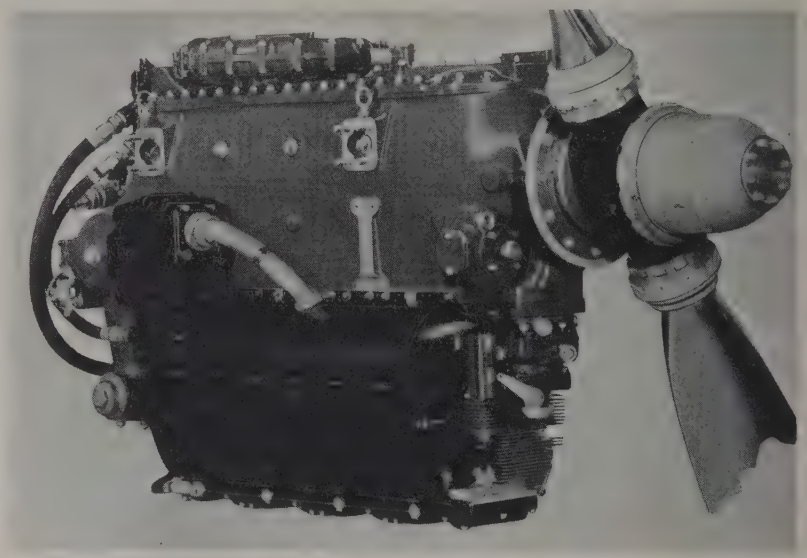
WEIGHT DRY (without accessories).—
145 kg. (320 lb.).

PERFORMANCE.—
Take-off output 170 h.p. at 2,600 r.p.m.
Normal output at sea level 155 h.p. at 2,500 r.p.m.
Max. cruising output 130 h.p. at 2,360 r.p.m.
Economic cruising output 105 h.p. at 2,260 r.p.m.

CONSUMPTIONS.—
At take-off 245 gr. (.54 lb.) h.p./hour.
At normal output (2,500 r.p.m.) 240 gr. (.53 lb.) h.p./hour.
At max. cruising 215 gr. (.47 lb.) h.p./hour.
At economical cruising 205 gr. (.45 lb.) h.p./hour.

THE POTEZ 4-D 30.

This is the previously described 4-D 00 fitted with a centrifugal blower mounted horizontally on the crankcase top cover. It has been chosen to power the Nord 3202 two-seat trainer and Nord 3400 observation aircraft.



The 240 h.p. Potez 4-D 30 four-cylinder supercharged engine.

The general description of the 4-D 00 applies to this engine except for the following details :—

CYLINDERS.—Same as for 4-D 00. Cylinder head shrunk on sleeve.

CONNECTING RODS.—I-section steel alloy forgings, machined all over.

INDUCTION.—Supercharged Zenith density-tachometric injection carburettor.

SUPERCHARGER. — Single-stage centrifugal type. High-strength die-forged aluminium-alloy impeller driven from front end of crankshaft through ground spur teeth, ground zerol bevel gearing and slipping coupling. Ratio 15.50 : 1.

FUEL.—100 Octane minimum. Up to 1.2 cc.'s of lead per litre accepted by engine.

LUBRICATION.—Same as for 4-D 00. Pressure feed to supercharger drive. Provision for scavenging of crankcase in inverted flight by gravity-sensitive dual valve.

DIMENSIONS.—
Same as for 4-D 00.

WEIGHT DRY (without accessories).—
183 kg. (403 lb.).

PERFORMANCE.—
Take-off output 240 h.p. at 2,550 r.p.m.
Normal output at 700 m. (2,300 ft.) 205 h.p. at 2,400 r.p.m.
Normal cruising output at 1,300 m. (4,400 ft.) 160 h.p. at 2,200 r.p.m.

CONSUMPTIONS.—
At take-off 290 gr. (.64 lb.) h.p./hour.
At normal output at S/L. 270 gr. (.595 lb.) h.p./hour.
At normal cruising 225 gr. (.49 lb.) h.p./hour.
At economical cruising 215 gr. (.47 lb.) h.p./hour.

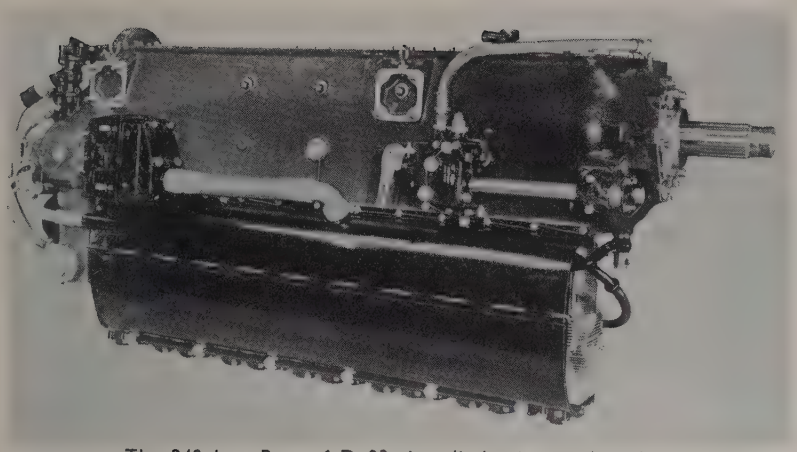
THE POTEZ 6-D 02.

TYPE.—Six-cylinder in-line inverted air-cooled.

CYLINDERS.—Same as for 4-D 00 except swept volume 8.83 litres (539 cub. in.).

PISTONS AND CONNECTING RODS.—Same as for 4-D 00.

CRANKSHAFT.—Six-throw, nitrided nickel-chrome-molybdenum steel, forged and machined all over. Deep-groove ball thrust



The 240 h.p. Potez 6-D 02 six-cylinder inverted engine.

bearing and seven steel-back lead-bronze lead-plated bearings. Solid splined airscrew shaft.

CRANKCASE.—Aluminium-alloy casting with dural flat top cover. Seven dural forged bearing caps secured by two and four chrome-nickel steel studs. Chrome-nickel steel through-bolts at three centre bearing caps. Seven camshaft journals. Cast magnesium-alloy oil sump in rear section of case

VALVE GEAR.—Same as for 4-D 00.

INDUCTION—Normally aspirated. Two Hobson A.I. 55/J carburettors with automatic altitude correction and enrichment. Fuel feed by AM Type CM 13 pump. Provision for aerobatics.

FUEL.—80 Octane minimum. Up to 1.2 cc.'s of lead per litre accepted by engine.

IGNITION.—Fully VHF screened. One double RB Type J6A magneto. Two 14 mm. spark-plugs per cylinder.

LUBRICATION.—Same as for 4-D 00. Provision for scavenging of crankcase in inverted flight by gravity-sensitive dual valve.

AIRSCREW DRIVE.—Direct, right-hand drive. Splines conforming to B.N.Ae. 212.01. Provision for hydraulic variable-pitch airscrew.

ACCESSORIES.—Drive for 24-volt 1,600-watt electric generator on left side rear of crankcase. Ratio 2.46 : 1 Tachometer drive on rear of crankcase. Ratio 0.5 : 1. Vacuum and hydraulic pump drives on rear of sump case. Ratios 1.07 : 1 and 0.67 : 1 respectively. Hydraulic airscrew regulator on right front side of crankcase. Ratio 0.5 : 1.

STARTING. — Potez electric 24-volt direct starter.

MOUNTING.—Four points, two forward and two aft of C.G.

COOLING.—Five inter-cylinder deflectors, one rear deflector and one side chute in two pieces, one movable. Maximum temperatures (at 2,500 r.p.m.) 250°C. cylinder heads, 150°C cylinder barrels.

DIMENSIONS.—
Overall length 1,550 mm. (61 in.).
Overall height 720 mm. (28.35 in.),
Overall width 530 mm. (20.87 in.).

WEIGHT DRY.—
Without accessories 235 kg. (517 lb.).

POWER RATING.—
Take-off output 240 h.p. at 2,530 r.p.m.
Normal output at sea level 230 h.p. at 2,500 r.p.m.
Max. cruising output 180 h.p. at 2,300 r.p.m.
Economic cruising output 135 h.p. at 2,100 r.p.m.

CONSUMPTIONS.—
At take-off 250 gr. (.55 lb.) h.p./hour.
At normal output (2,500 r.p.m.) 240 gr. (.53 lb.) h.p./hour.
At max. cruising 220 gr. (.48 lb.) h.p./hour.
At economical cruising 205 gr. (.45 lb.) h.p./hour.

THE POTEZ 6-D 30.

This is the above-described 6-D 02 fitted with a centrifugal blower mounted horizontally on the crankcase top-cover. The description of the 6-D 02 applies to this engine except for the following details :—

CYLINDERS.—Same as for 6-D 02. Cylinder-head shrunk-fitted on sleeve.

CONNECTING RODS.—I-section steel alloy forgings, machined all over.

INDUCTION. — Supercharged. Direct high pressure injection into cylinder head provided by Bronzavia swash-plate six-plunger pump Type 130-604 supported by crankcase at front right side and driven at camshaft speed by bevel gearing. Fully-automatic mixture control with automatic altitude and temperature controls. One injection nozzle per cylinder. No boost control. One throttle valve at supercharger outlet. First-stage fuel pump incorporated into injection pump.

SUPERCHARGER.—Same type as for 4-D 30. Ratio 14.0 : 1.

FUEL.—100/130 octane. Up to 1.2 cc.'s of lead per litre accepted by engine.

LUBRICATION.—Same as for 4-D 30. Pressure feed to supercharger drive. Provision for scavenging of crankcase in inverted flight by gravity-sensitive dual valve.

ACCESSORIES.—Drive for 24-volt 1,600 watt electric generator on left rear side of crankcase. Ratio 2.46 : 1. Tachometer drive on rear of crankcase. Ratio 0.5 : 1. Vacuum pump drive on rear of sump case. Ratio 1.07 : 1. Hydraulic pump drive on rear of crankcase. Ratio 0.5 : 1. Hydraulic airscrew regulator at rear of sump case. Ratio 0.67 : 1.

COOLING.—Same as for 4-D 30. Maximum temperatures (at 2,400 r.p.m.) 255°C. cylinder heads, 160°C. cylinder barrels.

DIMENSIONS.—
As for 6-D 02.

WEIGHT DRY.—
Without accessories 260 kg. (573 lb.).

POWER RATING.—
Take-off output 325 h.p. at 2,400 r.p.m.
Normal output 260 h.p. at 2,400 r.p.m.
Max. cruising output 200 h.p. at 2,200 r.p.m.

CONSUMPTIONS.—
At take-off 300 gr. (.66 lb.) h.p./hour.
At normal output 270 gr. (.595 lb.) h.p./hour.
At max. cruising 230 gr. (.51 lb.) h.p./hour.
At economical cruising 215 gr. (.47 lb.) h.p./hour.

THE POTEZ 8-D 30 AND 8-D 32.

The 8-D 32 engine powered the Potez 75 anti-tank and artillery observation aircraft. An 8-D 30 has been fully type-tested at a rating of 520 h.p. The two engines are similar, except that the Type 8-D 32 is a pusher-type power plant with stepped-up fan.

TYPE.—Eight-cylinder 90° inverted Vee air-cooled, geared and supercharged.

CYLINDERS.—Same as for 4-D 30, except swept volume 11.78 litres (719 cub. in.).

PISTONS.—Same as for 4-D 30.

CONNECTING RODS.—Fork and blade type in nitrided nickel-chrome-molybdenum steel, with split big-ends and split steel-backed lead-bronze lead-plated bearings. Assembly by four chrome-nickel steel bolts in fork rod and two in blade rod.

CRANKSHAFT.—Four-throw 90° dynamically-balanced one-piece shaft of nitrided nickel-chrome-molybdenum steel. Five split steel-backed lead-bronze lead-plated bearings. Drive to reduction gear and camshaft from serrated flange bolted to front end of shaft. On rear end is shrunk the flexible torsion shaft to the supercharger drive.

CRANKCASE. — Aluminium - alloy monobloc casting with cast magnesium-alloy top cover. Five dual forged bearing caps, three secured by four chrome-nickel steel studs, two by two studs. Chrome-nickel steel through-bolts at three centre bearing caps. Front of the crankcase closed by reduction-gear casing, rear end by supercharger casing and accessory support. Oil sump in rear portion of case and below compressor casing.

VALVE GEAR.—Same as for 4-D 30. Single camshaft in crankcase.

INDUCTION.—Supercharged. One Zenith 95 RGSL automatic carburettor with automatic altitude control and full throttle enrichment. Forced circulation of scavenge oil round intake elbow to blower. Fuel feed by A.M. pump type CM 13.

SUPERCHARGER. — Single-stage single-speed centrifugal supercharger. Ratio 9.83 : 1.

FUEL.—100 Octane minimum. Up to 1.2 cc.'s per litre lead accepted by engine.

IGNITION.—Fully VHF screened. Two R.B. Type P8BA magnetos. Two 14 mm. short reach spark-plugs per cylinder.

LUBRICATION.—Dry sump type. Two pressure and three scavenge pumps. Oil pressure 35.5-71 lb./sq. in. (2.5-5 kg./cm.²). Provision for scavenging of crankcase in inverted flight by gravity-sensitive dual valve.

REDUCTION GEAR.—Planetary type with seven satellites. Gear ratio 0.657 : 1.

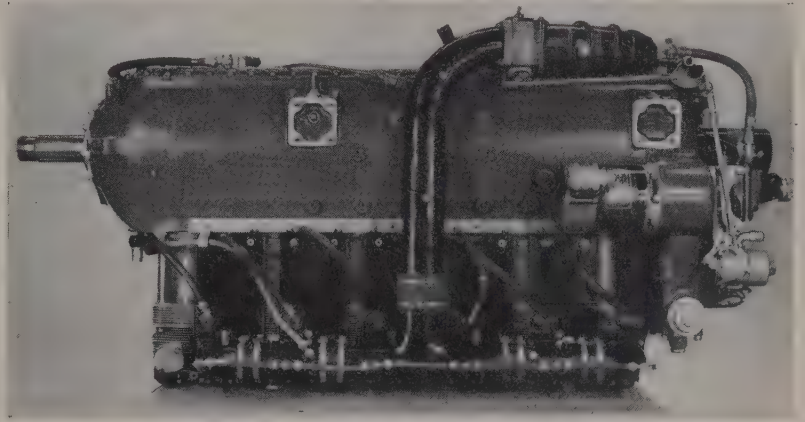
AIRSCREW DRIVE.—Direct, right-hand drive. Airscrew shaft with 16 splines 73.3 × 67.7 × 7.4. Provision for hydraulic variable-pitch airscrew.

ACCESSORIES.—Drive for 24-volt 2,500-watt electric generator over supercharger casing. Ratio 2.27 : 1. Tachometer drive on right side of supercharger casing : ratio 0.5 : 1. Vacuum pump on rear (right) of accessories support : ratio 1 : 1. Hydraulic pump on rear (left) of accessories support : ratio 1 : 1. Hydraulic airscrew regulator : ratio 0.5 : 1 at front of reduction gear casing.

STARTING.—Potez 24-volt electric starter mounted in Vee of engine.

MOUNTING.—Four-point flexible mounting, two points forward and two aft of C.G.

COOLING.—Six inter-cylinder deflectors, one rear deflector and one under-scoop. Temperatures as for 6-D 30. This engine can be supplied as a pusher-type with incorporated stepped-up fan and becomes the type 8-D 32.



The 325 h.p. Potez 6-D 30 six-cylinder supercharged engine.

DIMENSIONS.—
Overall length 1,694 mm. (66.3 in.).
Overall width 795 mm. (31.3 in.).
Overall height 802 mm. (31.6 in.).
WEIGHT DRY.—
Type 8-D 30 (without accessories) 335 kg. (738 lb.).
Type 8-D 32 (without accessories) 353 kg. (778 lb.).
POWER RATINGS.—
Take-off output 520 h.p. at 2,650 r.p.m.
Normal output at 1,900 m. (6,230 ft.) 430 h.p. at 2,650 r.p.m.
Econ. cruising output at 3,300 m. (10,825 ft.) 290 h.p. at 2,250 r.p.m.
CONSUMPTIONS.—
At take-off 310 gr. (.68 lb.) h.p./hour.
At normal output 280 gr. (.62 lb.) h.p./hour.
At max. cruising 225 gr. (.49 lb.) h.p./hour.
At economical cruising 215 gr. (.47 lb.) h.p./hour.

SNECMA.

SOCIÉTÉ NATIONALE D'ETUDE ET DE CONSTRUCTION DE MOTEURS D'AVIATION.

HEAD OFFICE: 150, BOULEVARD HAUSSMANN, PARIS (8e.)

WORKS: PARIS (BOULEVARD KELLERMANN), GENNEVILLIERS (SEINE), BILLANCOURT (SEINE), SURESNES (SEINE) AND MELUN-VILLAROCHE (SEINE-ET-MARNE).

President and Director-General: Henri Desbruères.

Administrative Director: M. Depallens.

Technical Director: H. Oestrich.

Director-Controller: Marcel Richer.

Commercial Director: André Esperet.

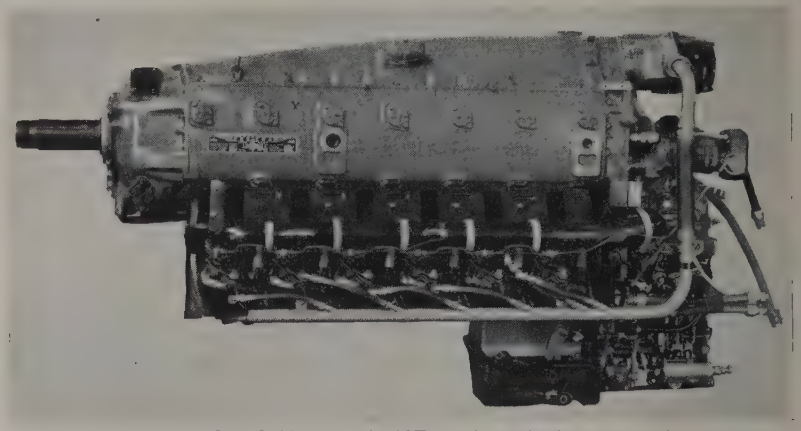
Director of External Relations: Maurice Roudil.

Director of Atomic Division: Raymond Marchal.

Personnel Manager: D. Dugue MacCarthy.

The Société Nationale d'Etude et de Construction de Moteurs d'Aviation. (SNECMA) is the successor to the Société de Moteurs Gnôme-et-Rhône which was nationalised in 1945. In 1946 Renault Aviation was incorporated in SNECMA.

The Company is no longer designing new piston-engines, but it continues to manufacture at its Billancourt works the Renault 12T in-line inverted air-cooled engine, and is building the Hercules 759 engine under licence from the Bristol Aeroplane Co., Ltd. to power the Nord 2501 Noratlas transport and its derivitives. It also continues to service and repair the Régnier 4L, Renault 4P and 6Q and Gnôme-Rhône 14N, 14M and 14R engines, which are no longer in production.



The 600 h.p. SNECMA Renault 12T twelve-cylinder inverted engine.

SNECMA is now devoting the major part of its activities to the development and series production of gas-turbine engines, for details of which see under "SNECMA" in Part I of this Section.

THE SNECMA RENAULT 12T.

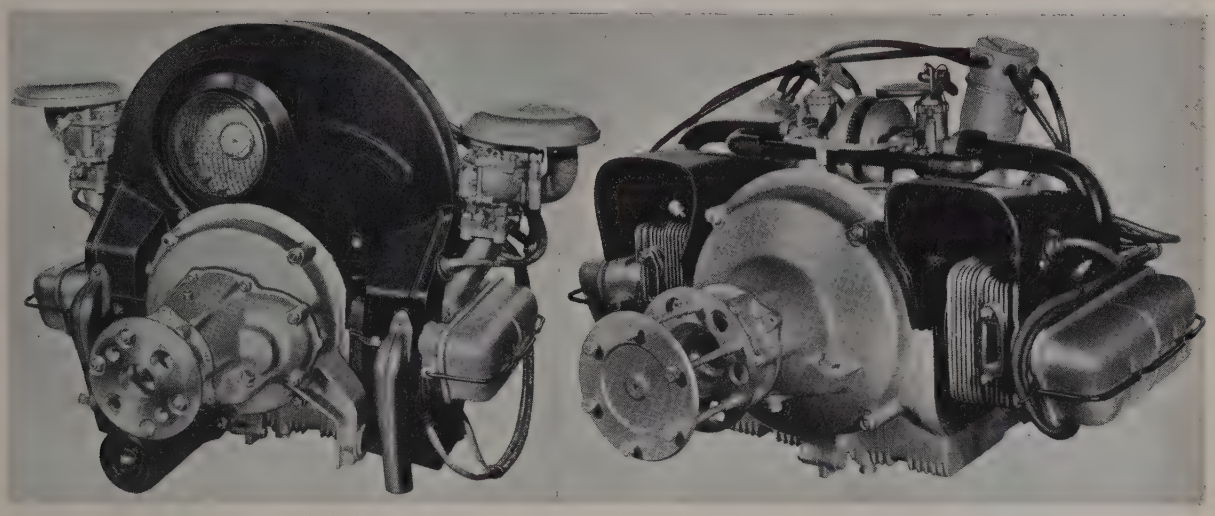
The SNECMA Renault 12T has replaced in production the SNECMA Renault 12S which has been described in previous editions of "All the World's Aircraft." The main differences between the two engines concern the pistons, supercharger and lubrication, but further details were not available at the time of writing.

DIMENSIONS.—
Length 1,366 mm. (53.7 in.).
Height 755 mm. (29.7 in.).
Width 500 mm. (19.6 in.).
PERFORMANCE.—
Take-off output 600 h.p. at 3,300 r.p.m. at S/L.
Take-off output 625 h.p. at 3,300 r.p.m. at 600 m. (1,970 ft.).
Max. continuous output 506 h.p. at 3,250 r.p.m. at 2,400 m. (7,870 ft.).
Max. cruising output 390 h.p. at 2,600 m. (8,530 ft.).
FUEL CONSUMPTIONS.—
Max. continuous 188 litres (41.3 Imp. gallons) per hour.
Max. cruising 102 litres (22.4 Imp. gallons) per hour.
Recommended cruising 84 litres (18.4 Imp. gallons) per hour.

GERMANY

THE GERMAN FEDERAL REPUBLIC

PORSCHE



The Porsche 678/0 (left) and 678/3 (right) four-cylinder horizontally-opposed air-cooled engines.

Dr.-ING. h.c. F. PORSCHE K.-G.

HEAD OFFICE AND WORKS: 25, MORITZ-HORKHEIMER STRASSE, STUTTGART-ZUFFENHAUSEN.

This well-known manufacturer of sports cars is producing the first aero-engine developed in Germany since the war. Known as the Porsche Type 678, it is an air-cooled horizontally-opposed four-cylinder engine intended to meet the requirement for a power plant for the many light sporting aircraft now being built in Europe, and is produced in three versions, as described below. Previously, many amateur constructors had fitted modified Porsche motor car engines to aircraft of the Jodel type with considerable success.

THE PORSCHE 678/0.

TYPE.—Four-cylinder horizontally-opposed air-cooled.

CYLINDERS.—Bore 82.5 mm. (3.25 in.). Stroke 74 mm. (2.91 in.). Swept volume 1,582 cc. (96.5 cub. in.). Compression ratio 7.5 : 1. Light alloy components, with one-piece head for each pair of cylinders.

PISTONS.—Light alloy components. Three piston rings.

CONNECTING RODS.—Made of steel with lead-bronze steel-backed big-end bearings and bronze little-end bearings.

CRANKSHAFT.—Forged type with four light alloy bearings.

CRANKCASE.—Light alloy chilled casting.

VALVE GEAR.—Overhead valves. One exhaust and one inlet valve per cylinder. Steel valves. Inlet valves have bronze seats, exhaust valves have steel seats. Gear-driven camshaft underneath crankshaft.

INDUCTION.—Two Pallas Zenith type 32 NDIZF carburettors.

FUEL GRADE.—80 octane.

IGNITION.—Dual ignition from 12 volt battery or Scintilla-Vertex-Magnetzundung type OK 4 L 10 high-tension magneto driven from crankshaft. Two Bosch V 2930 spark plugs and Bosch ignition harness.

LUBRICATION.—Dry sump type. Gear-type pumps.

OIL GRADE.—Shell Rotella SAE 30.

AIRSCREW REDUCTION GEAR.—Gear ratio 1.7 : 1. SAE-flange drive-shaft.

STARTING.—12-volt electric starter.

DIMENSIONS.—
No details available.

WEIGHT.—
Dry 87 kg. (192 lb.).

PERFORMANCE RATINGS.—
Take-off output 65 h.p. at 4,500 r.p.m.
Max. continuous output 55 h.p. at 4,200 r.p.m.
Economical cruising output 50 h.p. at 4,080 r.p.m.

CONSUMPTIONS.—
Fuel at max. continuous output approx. 18 litres (3.96 Imp. gallons)/hr.
Fuel at economical cruising output approx. 16 litres (3.52 Imp. gallons)/hr.
Oil at max. continuous output approx. 0.2 litres (0.35 Imp. pints)/hr.

THE PORSCHE 678/1.

The Porsche 678/1 is similar to the 678/0, except that it has only one Pallas Zenith type 32 NDIZF carburettor and has a reduction gear ratio of 2.12 : 1.

Before the Type 678/1 engine was put on the market, it completed successfully a 150 hour type test to British A.R.B. Certificate of Airworthiness standards at the official West German Aviation Research Centre in Brunswick. On the basis of this testing, it has been released for service with an initial overhaul period of 600 hours and is suitable for installation in aircraft with a maximum speed of up to about 200 km.h. (135 m.p.h.).

WEIGHT.—
Dry 85 kg. (187 lb.).

PERFORMANCE RATINGS.—
Same as for Porsche 678/0.

CONSUMPTIONS.—
Fuel at max. continuous output approx. 17 litres (3.74 Imp. gallons)/hr.
Fuel at economical cruising output approx. 15.5 litres (3.41 Imp. gallons)/hr.
Oil at max. continuous output approx. 0.2 litres (0.35 Imp. pints)/hr.

THE PORSCHE 678/3.

The Porsche 678/3 is basically similar to the 678/0. Following are the main differences :—

INDUCTION.—Two special Bing type 6/24 carburettors.

IGNITION.—Only magneto dual ignition. Two Scintilla-Vertex-Magnetzundung type OK 4 L 10 magnetos. Two Bosch type V 2930 spark plugs. Scintilla ignition harness.

LUBRICATION.—Wet sump type. Gear-type pumps.

AIRSCREW DRIVE.—Ungeared type. SAE-flange shaft.

STARTING.—Hand-crank type.

WEIGHT.—
Dry 70 kg. (154 lb.).

PERFORMANCE RATINGS.—
Take-off output 52 h.p. at 3,200 r.p.m.
Max. continuous output 50 h.p. at 3,150 r.p.m.
Economical cruising output 40 h.p. at 2,950 r.p.m.

CONSUMPTIONS.—
Fuel at max. continuous output 15.5 litres (3.41 Imp. gallons)/hr.
Fuel at economical cruising output 12 litres (2.64 Imp. gallons)/hr.
Oil at max. continuous output 0.15 litres (0.26 Imp. pints)/hr.

THE GERMAN DEMOCRATIC REPUBLIC

Development and production of aero-engines in East Germany is, like the construction of aircraft, carried out in a state-owned factory known as the Industriewerk Karl Marx Stadt, which comes under the direction of the following organisation.

VEREINEGUNG VOLKSEIGENER BETRIEBE FLUGZEUGBAU (Association of State-owned Aircraft Factories).

HEADQUARTERS: PIRNA/ELBE.

The aero-engine factory at Chemnitz was opened in 1954 and concentrated initially on production under licence of the 1,900 h.p. Soviet ASh-82T piston-engine. This engine, which powers the Il-14P airliners which are being built under licence in East Germany, is described fully in the Soviet section of this work.

Details of turbojet development in East Germany will be found in the "Gas-Turbines" section.

ITALY

AGUSTA

MECCANICA VERGHERA S.p.A.

HEAD OFFICE: CASCINA COSTA, GALLARATE.

ENGINE WORKS: VERGHERA, GALLARATE.

This company is the Engine Division of the Agusta company, whose airframe production is described in the "Aircraft" section of this work.

It has produced a range of completely new small piston engines for the propulsion of fixed-wing aircraft and helicopters, to the designs of M. Ginnini. These are now being bench-tested and are described briefly below.

In addition to designing and building aero-engines, Meccanica Verghera manufactures trucks and motor-cycles. Its motor-cycles have won the World's Championship in the 125 cc. and 250 cc. classes on many occasions.

THE AGUSTA G.A. 70/V.

The G.A. 70/V has been designed to be mounted with its crankshaft vertical for helicopter propulsion.

TYPE.—Four-cylinder horizontally-opposed air-cooled.

CYLINDERS.—Bore 92 mm. (3.62 in.). Stroke 86.5 mm. (3.41 in.). Total swept volume 2,300 cc. (140.4 cub. in.). Compression ratio 7.2 : 1. Steel barrels with large fin area. Barrels attached to crankcase by flange and studs. Aluminium alloy heads with large fin area screwed on to cylinder barrels.

PISTONS.—Made from aluminium alloy with two compression rings and two oil scraper rings. Gudgeon-pin of treated steel.

CONNECTING RODS.—I-section alloy steel forgings with small bronze bushings. Big end caps are inserted by means of retention bolts.

CRANKSHAFT.—Nitrided steel one-piece forging, with three main bearings. Two thrust bearings, crankshaft main bushings and connecting rod bushings are Vandervell thin-wall type. Crankshaft is positioned vertically.

CRANKCASE.—Elektron casting in two halves.

VALVE GEAR.—Two intake and two exhaust valves per cylinder. Valves are special alloy steel with stellite surfaces. Face angle of exhaust valves 45°, of intake valves 30°. Valve-seats are "xantal" bronze. Single camshaft. Valves actuated through rocker arms.

INDUCTION.—Stromberg carburettor.

FUEL GRADE. 90 octane.

IGNITION.—Dual ignition. Marelli magnetos. Two Marelli shielded spark plugs per cylinder.

LUBRICATION.—Pressure type, with gear-driven pump.

REDUCTION GEAR. Reduction gearbox can be installed by customer. Left-hand rotation as viewed from top.

ACCESSORIES.—Accessory drives are provided for tachometer, fuel pump and optional accessories.

STARTING.—Marelli electric starter.

MOUNTING.—Three flexible mounting points.

DIMENSIONS, WEIGHTS AND POWER RATINGS.—See table.

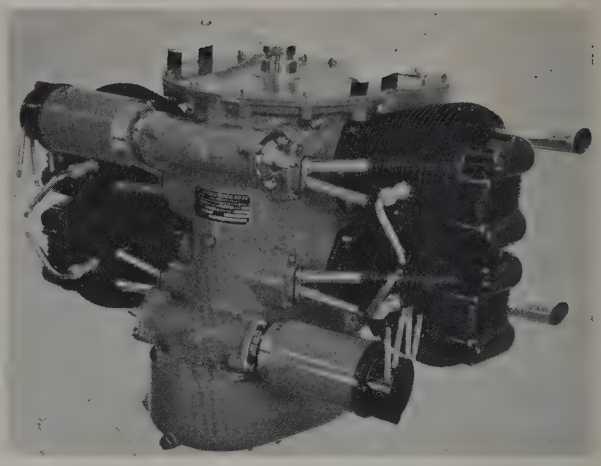
THE AGUSTA G.A. 70/0.

Basically similar to the G.A. 70/V, this engine is designed to power fixed-wing aircraft and has a conventional horizontal crankshaft. It is fitted with reduction gearing and has four flexible mounting points.

DIMENSIONS, WEIGHTS AND POWER RATINGS.—See table.

THE AGUSTA G.A. 40.

Smallest of the current range of Agusta engines, the G.A. 40 is in limited production to power a motorised glider for the Italian Air Force.



The 82 h.p. Agusta G.A. 70/V helicopter power plant.

TYPE.—Two-cylinder horizontally-opposed air-cooled.

CYLINDERS.—Bore 100 mm. (3.94 in.). Stroke 95 mm. (3.74 in.). Total swept volume 1,486 cc. (90.68 cub. in.). Compression ratio 7.2 : 1. Steel barrels with large fin area. Barrels attached to crankcase by flange and studs. Aluminium alloy heads with large fin area screwed on to barrels.

PISTONS.—Aluminium alloy, with two compression rings and two oil scraper rings. Gudgeon-pin of treated steel.

CONNECTING RODS.—I-section alloy steel forgings with small bronze bushings. Big end caps inserted by means of retention bolts.

CRANKSHAFT.—Nitrided steel one-piece forging, with two main bearings and one thrust bearing. Crankshaft main bushings and connecting rod bushings are Vandervell thin-wall type.

CRANKCASE.—Elektron casting in two halves.

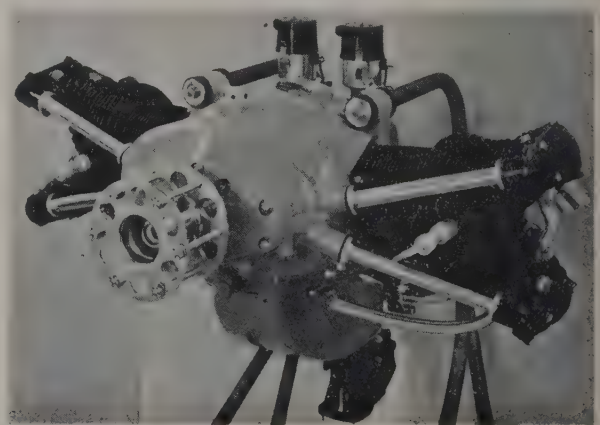
VALVE GEAR.—Two intake and two exhaust valves per cylinder. Valves of special alloy steel with stellite surfaces. Face angle of intake valves 30°, of exhaust valves 45°.

AGUSTA HORIZONTALLY-OPPOSED ENGINES.

Engine Model	No. of Cylinders	Rated Output at Sea Level	Capacity	Weight Dry	Overall Length	Overall Width	Overall Height
G.A.40	2	42 h.p. at 2,700 r.p.m.	1,486 cc. (90.68 cub. in.)	43 kg. (95 lb.)	612 mm. (24.09 in.) (less carb.)	785 mm. (30.90 in.)	390 mm. (15.35 in.) (less carb.)
G.A.70/0	4	83 h.p. at 3,500 r.p.m.	2,300 cc. (140.4 cub. in.)	74 kg. (163 lb.)	750 mm. (29.53 in.)	745 mm. (29.33 in.)	450 mm. (17.72 in.) (less carb.)
G.A.70/V	4	82 h.p. at 3,500 r.p.m.	2,300 cc. (140.4 cub. in.)	72 kg. (159 lb.)	540 mm. (21.26 in.) (over carb.)	735 mm. (28.94 in.)	580 mm. (22.83 in.)

On the left, the 83 h.p. Agusta G.A.70/0 four-cylinder and, below, the 42 h.p. Agusta G.A.40 two-cylinder opposed air-cooled engines.





Valve-seats are of "xantal" bronze. Dual camshaft for inlet and exhaust valves respectively. Valves actuated through rocker arms.
INDUCTION.—Stromberg carburettor.
FUEL GRADE.—90 octane.
IGNITION.—Dual ignition. Marelli gear-driven magnetos. Two Marelli shielded spark plugs per cylinder.
LUBRICATION.—Pressure lubrication, with gear-driven pump.
AIRSCREW DRIVE.—Designed for wooden airscrew. Anti-clockwise drive. No reduction gear.
ACCESSORIES.—Tachometer drive provided.
STARTING.—Manual.
MOUNTING.—Four flexible mounting points.
DIMENSIONS, WEIGHTS AND POWER RATINGS.—
See table.

ALFA

SOCIETÀ per AZIONI ALFA ROMEO.

HEAD OFFICE : VIA GATTAMELATA 45, MILAN.

AERO-ENGINE WORKS : POMIGLIANO D'ARCO, NAPLES.

This company, manufacturers of the well-known Alfa-Romeo automobile, entered the Italian aero-engine industry in 1925 with the acquisition of the Jupiter engine licence from the Bristol Aeroplane Co., Ltd., and the Lynx engine licence from Armstrong Siddeley Motors, Ltd. In 1930, the company produced its first engine of original design, the D2, and remained an important manufacturer of piston-engines for Italian aircraft until 1956.

Pending conversion of its plant for the manufacture of gas-turbine engines, Alfa Romeo is restricting its aero-engine work to the overhaul of piston-engines of up to 3,500 h.p., turbojet and turboprop engines.

POLAND

In common with the airframe industry, Polish aero-engine factories were engaged mainly in producing equipment of Soviet design until recently, when development of nationally-designed engines has again been encouraged.

Several Russian aero-engines were manufactured in Poland and the AI-14R seven-cylinder air-cooled radial, which develops a maximum of 260 h.p., is still in production.

Details of turbojet, pulse-jet and ram-jet engines produced in Poland are given in the "Gas-Turbines" section of this work.

NARKIEWICZ

DIPL. ING. WIKTOR NARKIEWICZ.

Best known Polish aero-engine designer at the present time is Dipl. Ing. Wiktor Narkiewicz who, as technical director of the Avia works, supervised construction of the pre-war WZ-7 and WZ-100 radial engines and was engaged on engine research in Britain during the war.

Between the years 1946 and 1958 Narkiewicz, working successively as a chief designer of the C.S.S. (Central Engine Office) and the Aero-engine Department of the I.L. (Aviation Institute), evolved several piston engines of his own design. With the formation of the O.K.L. (Aircraft Construction Centre) at the W.S.K. Warsaw-Okecie in October, 1957, he became a leader of the Aero-engine Design Team incorporated in this Centre, and is now actively engaged on the development of the WN-1, WN-6, WN-6R, WN-7 and WN-7R engines. Descriptions of these engines follow hereafter.

Narkiewicz is also reported to be preparing a design study for a turboprop engine in the 1,000 s.h.p. class, and a light turbojet engine to power the TS-11 Iskra trainer.

THE WN-1.

Known originally as the PZL-65 KM, the WN-1 was developed in 1947/8 to the requirement of the Department of Civil Aviation of the Ministry of Communications. The WN-1 prototype underwent successfully a full programme of ground and flight testing and a small development batch was produced in the C.S.S. works. When the Department of Civil Aviation was dissolved all further work on the WN-1 was abandoned.

The WN-1 was revived recently, and, after some modifications, is now entering quantity production. A new 30-35 h.p. two-cylinder horizontally-opposed engine is also being evolved from the basic WN-1 design.

The following description applies to the WN-1 :—

TYPE.—Four-cylinder horizontally-opposed air-cooled.
CYLINDERS.—Bore 100 mm. (3.93 in.). Stroke 92 mm. (3.62 in.). Capacity 2.88 litres (176 cub. in.). Compression ratio 6.3 : 1. Nitrided steel barrels with aluminium alloy cylinder heads screwed on.
CRANKSHAFT.—One-piece nitrided steel forging with four throws and running on three bearings.
CRANKCASE.—Aluminium alloy case in two parts, split in vertical plane.
VALVE GEAR.—One inlet and one exhaust valve per cylinder.
INDUCTION.—One Zenith carburettor. Autocar-type fuel pump.
FUEL.—72 octane minimum.
IGNITION.—One RB-14 double magneto. Two 24 mm. (0.94 in.) plugs per cylinder. Screening optional.
LUBRICATION.—Wet sump pressure lubrication. Normal oil pressure 4-5 kg./cm.² (56.8-71 lb./sq. in.). Oil tank capacity 6 litres (1.31 Imp. gal.).
DIMENSIONS.—
Overall length 71.8 cm. (28.26 in.).
Overall height 59.2 cm. (23.3 in.).
Overall width 81.8 cm. (32.2 in.).
Frontal area 0.35 m.² (3.77 sq. ft.).
WEIGHT.
58 kg. (127.9 lb.).
PERFORMANCE.—
Take-off power (1 min. 30 sec.) 65 h.p. at 2,500 r.p.m.
Normal continuous power 58 h.p. at 2,400 r.p.m.
Economical cruise power 50 h.p. at 2,300 r.p.m.
CONSUMPTION.—Fuel at cruising power 215 gr. (0.48 lb.) per h.p./hr.
Oil at cruising power 6 gr. (0.013 lb.) per h.p./hr.

THE WN-2.

In 1948, Narkiewicz designed the 280 h.p. WN-2 to an official specification and several prototypes of this engine were completed at the C.S.S. works in 1949/50 and successfully tested. In 1950 the C.S.S. was dissolved and the WN-2 abandoned in favour of the licence-built Soviet AI-14.

No details of the WN-2 are available.

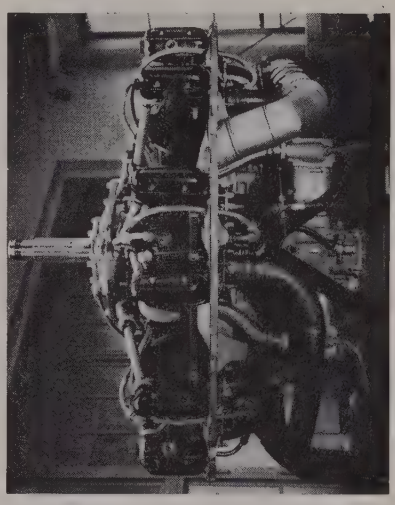
THE WN-3.

In the Autumn of 1952 Narkiewicz organised a small design team at the I.L. and started work on a new engine, the 300 h.p. WN-3 seven-cylinder radial. The prototype was completed in 1954 and all testing was finished before the end of 1955, the maximum power being increased under development to 340 h.p. at 2,500 r.p.m. with no increase in weight. The WN-3 is now in large-scale production, mainly for the TS-8 Bies trainer, and a special version known as the WN-4 has been developed to power the Zuk helicopter.

In 1955 the basic WN-3 design was developed into the 450 h.p. WN-5 geared radial engine. The WN-5 received no official support and has not so far been built.

The following details apply to the WN-3 :—

TYPE.—Seven-cylinder radial air-cooled.
CYLINDERS.—Bore 135 mm. (5.31 in.). Stroke 134 mm. (5.27 in.). Capacity 13.4 litres (820 cub. in.). Compression ratio 6.2 : 1. Nitrided steel barrels and aluminium alloy cylinder heads.



The 340 h.p. Narkiewicz WN-3 engine

CRANKSHAFT. — Two-piece counterbalanced shaft, carried in two roller and one ball bearing.
CRANKCASE.—Cast in two halves in aluminium alloy.
VALVE GEAR.—One inlet and one exhaust valve per cylinder with induction-hardened stems, actuated by push-rod and rocker system.
INDUCTION.—One K-14WN carburettor with manually-operated altitude mixture control. One BNK-12 fuel pump.
FUEL.—72 octane minimum.
IGNITION.—Two BSM-7M magnetos with fully-screened harness. Two M-18 plugs per cylinder.
LUBRICATION.—Dry sump system. One Kuno oil filter. Pressure-lubricated valve rockers. Normal oil pressure 5-6 kg./cm.² (71-86 lb./sq. in.).
AIRSCREW SHAFT.—SAE No. 20 standard spline. One oil channel for a variable-pitch airscrew.
ACCESSORIES.—1,500 watt generator, gear ratio 2.31 : 1; compressor, gear ratio 0.8 : 1; vacuum pump, gear ratio 0.8 : 1; and constant speed unit, gear ratio 1 : 1.
STARTING.—Compressed air starting.
DIMENSIONS.—
Diameter 1,106 mm. (43.5 in.).
Length 885 mm. (34.9 in.).
Frontal area 0.96 m.² (10.3 sq. ft.).
WEIGHT DRY.—
240 kg. (530 lb.).
PERFORMANCE.—
Take-off power 320 h.p. at 2,350 r.p.m.
Max. power (5 min.) 340 h.p. at 2,500 r.p.m.
Normal continuous power 285 h.p. at 2,250 r.p.m.
Economical cruise power 240 h.p. at 2,100 r.p.m.
CONSUMPTIONS.—
Fuel at cruising power 215 gr. (0.48 lb.) per h.p./hr.
Oil at cruising power 5 gr. (0.011 lb.) per h.p./hr.

THE WN-6.

TYPE.—Six - cylinder horizontally - opposed air-cooled.

CYLINDERS.—Bore 125 mm. (4.92 in.). Stroke 94 mm. (3.7 in.). Capacity 6.9 litres (421 cub. in.). Compression ratio 6.5 : 1. Nitrided steel barrels with aluminium alloy head screwed on.

CRANKSHAFT.—One-piece nitrided steel forging with six throws on four lead-bronze bearings. Forward part replaceable, running on roller bearing.

CRANKCASE.—Magnesium alloy case in two parts, split in vertical plane.

VALVE GEAR.—One inlet and one exhaust valve per cylinder, actuated by push-rod and rocker system.

INDUCTION.—One K-14BP carburettor with manually-operated altitude mixture control. One 702 M fuel pump.

FUEL.—72 octane minimum.

IGNITION.—One RB C4/6 double magneto with fully-screened harness. Two 14 mm. (0.55 in.) plugs per cylinder.

LUBRICATION.—Dry sump pressure system. Normal oil pressure 5-6 kg./cm.² (71-85.2 lb./sq. in.). Pressure lubricated valve rockers.

ACCESSORIES.—1,500 watt generator, compressor, and constant speed unit.

STARTING.—Compressed air or electric starter.

DIMENSIONS.—
Overall length 109 cm. (42.9 in.).
Overall height 42 cm. (16.53 in.).
Overall width 83 cm. (32.67 in.).
Frontal area 0.28 m.² (3.01 sq. ft.).

WEIGHT.—
157 kg. (346.1 lb.).

PERFORMANCE.—
Take-off power (5 min.) 180 h.p. at 2,600 r.p.m.
Normal continuous power 160 h.p. at 2,500 r.p.m.
Cruising power 140 h.p. at 2,300 r.p.m.

CONSUMPTION.—
Fuel at cruising power 215 gr. (0.48 lb.) per h.p./hr.
Oil at cruising power 5 gr. (0.011 lb.) per h.p./hr.

THE WN-6R.

The WN-6R is a geared version of the WN-6. It is fitted with a 0.66 : 1 ratio planetary reduction gear. In most other respects the engine is identical to the WN-6.

DIMENSIONS.—
Overall length 124 cm. (48.81 in.).
All the other dimensions are identical to those for the WN-6.

PERFORMANCE.—
Take-off power (5 min.) 220 h.p. at 3,200 r.p.m.
Normal continuous power 185 h.p. at 3,000 r.p.m.
Cruising power 155 h.p. at 2,800 r.p.m.

THE WN-7.

The WN-7 differs from the WN-6 in having four instead of six cylinders. Otherwise the two engines are constructionally the same and incorporate identical major components.

DIMENSIONS.—
Overall length 94 cm. (37 in.).
Overall height 52 cm. (20.47 in.).
Overall width 83 cm. (32.67 in.).
Frontal area 0.30 m.² (3.23 sq. ft.).

WEIGHT.—
105 kg. (231.5 lb.).

PERFORMANCE.—
Take-off power (15 min.) 125 h.p. at 2,500 r.p.m.
Normal continuous power 110 h.p. at 2,350 r.p.m.
Cruising power 95 h.p. at 2,100 r.p.m.

CONSUMPTION.—
Fuel at cruising power 210 gr. (0.47 lb.) per h.p./hr.
Oil at cruising power 6 gr. (0.013 lb.) per h.p./hr.

THE WN-7R.

This is a geared version of the WN-7 and apart from being fitted with a 0.63 : 1 ratio planetary reduction gear the WN-7R is identical to the WN-7. It has a T.O. rating of 145 h.p.

SOVIET UNION

(The Union of Soviet Socialist Republics)

A I

A. IVCHENKO.

In post-war years a series of piston-engines has been developed by A. Ivchenko for installation in light aeroplanes, and especially helicopters.

This designer is a newcomer to the Russian aeronautical scene, and full technical details of the motors are so far lacking. Those which have been mentioned are listed below.

THE AI-4G.

This power unit was designed for ultra-light helicopters and was used to power the Ka-10. It gives 55 h.p. at 4,500 r.p.m.

THE AI-14R.

The AI-14R is installed in the Yak-12 monoplane. It is a nine-cylinder radial air-cooled engine of 220 h.p. This motor is also used in the Ka-15.

THE AI-26B.

The most powerful Ivchenko engine so far announced is the AI-26B, which is used to power the Mi-1 helicopter. It is a seven-cylinder air-cooled radial engine giving 575 h.p. at 2,200 r.p.m.

ASH

A. D. SHVETSOV.

THE ASH-82T.

The ASh-82T was developed by the Soviet designer A. D. Shvetsov from the Pratt & Whitney Twin Wasp design. It is in production in both Russia and East Germany, and the following details were supplied from Germany.

TYPE.—Fourteen-cylinder two-row air-cooled radial, geared and supercharged.

CYLINDERS.—Bore 155.5 mm. (6.12 in.). Stroke 155 m. (6.10 in.). Displacement 41.2 litres (2,513 cub. in.). Nitrided steel barrel with cast aluminium alloy head. Compression ratio 6.9 : 1.

PISTONS.—Of forged aluminium. Each piston has three compression rings, one oil scraper ring and one oil seal ring. Upper compression ring of chromium-plated steel, remainder of cast iron. Bearing surfaces graphited. Gudgeon pins secured against axial movement by mushroom heads.

CONNECTING RODS.—Master rod and six articulated rods for each row. All rods of forged steel, heat-treated and polished. Bearings of lead-coated bronze.

CRANKSHAFT.—Three-piece crankshaft of heat-treated forged chrome-nickel-molybdenum steel. Bearing surfaces nitrided. Supported in three roller bearings.

CRANKCASE.—Made up of front housing, six-part centre housing, front and rear supercharger casings, and rear cover, all joined together by set-screws and studs. Centre housing containing cylinders is of steel, all other parts of light alloy. Front housing contains reduction gear and drives for magneto, airscrew governor and oil pump.

VALVE GEAR.—One inlet and one exhaust valve per cylinder, of heat-resisting steel. Exhaust valves are hollow and sodium-filled. Each row of cylinders has independent valve gear, consisting of camshaft, push-rods, valve levers, springs and valves.

INDUCTION SYSTEM.—Direct injection system, with injection pump on rear cover.

FUEL GRADE.—Not less than 95 octane.

SUPERCHARGER.—Single-stage type. Drive from crankshaft to light alloy impeller through reduction gearing with 7.27 : 1 ratio.

LUBRICATION.—Two oil pumps, one for each row.

IGNITION.—Two magnetos on front housing. Screened ignition harness.

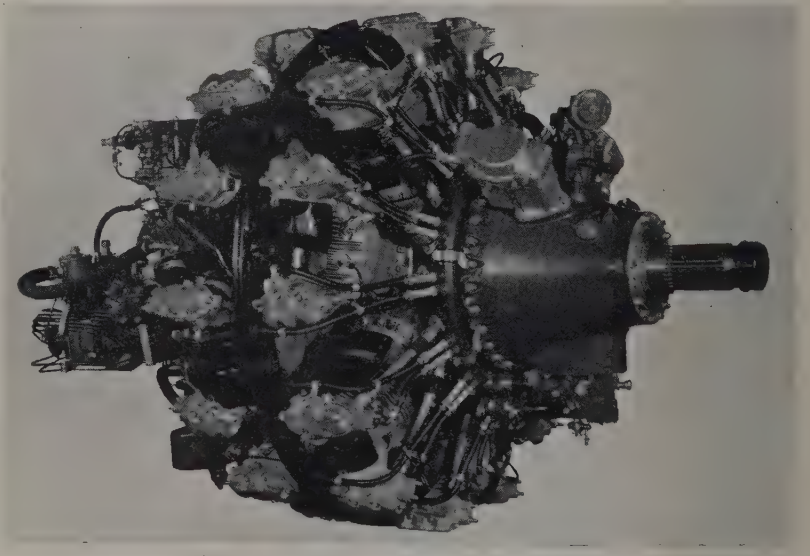
AIRSCREW DRIVE.—Provision for four-blade hydraulically - operated constant - speed variable-pitch airscrew with fluid de-icing. Reduction gear ratio 54 : 31.

DIMENSIONS.—
Diameter 1,300 mm. (51.18 in.).
Length 2,010 mm. (79.13 in.).

WEIGHT DRY.—
1,020 kg. (2,250 lb.).

PERFORMANCE.—
Take-off output (5 min.) at S/L 1,900 h.p. at 2,600 r.p.m.
Rated power at S/L 1,530 h.p. at 2,400 r.p.m.
Rated power at 1,600 m. (5,250 ft.) 1,630 h.p. at 2,400 r.p.m.

CONSUMPTIONS.—
Take-off power 617-655 kg./hr. (1,360-1,444 lb./hr.).
Rated power 435-480 kg./hr. (959-1,058 lb./hr.).



The 1,900 h.p. ASh-82T fourteen-cylinder radial engine.

SPAIN

E.N.M.A.

EMPRESA NACIONAL DE MOTORES DE AVIACIÓN S.A.

HEAD OFFICE: CALLE DE ANTONIO MAURA 4, MADRID.

WORKS: PASEO DEL GENERAL MOLA, 39, BARCELONA, AND CARRETERA DE SAN ADRIAN S/N, SAN ANDRES, BARCELONA.

President: Ilmo. Sr. D. Modesto Aguilera Morente.

Managing Director: Jose Ma. Brusés Davis.

The Empresa Nacional de Motores de Aviación, which took over the Elizalde organization on January 1, 1952, is manufacturing the 93 h.p. Flecha F-IV-1 flat-four engine, the Tigre G-IV four-cylinder inverted air-cooled engine, of which there are two models A and B with outputs of 125 and 150 h.p. respectively, the 500 h.p. Sirio S2 seven-cylinder radial and the 775 h.p. Beta B-4A nine-cylinder radial.

Under development are the 275 h.p. Alcion A-1 seven-cylinder radial, and the new Sirio S-3 and Beta B-5, both with reduction gearing.

The E.N.M.A. Flecha powers the AISA I-11 and I-11B light aircraft. The E.N.M.A. Tigre in both its 125 and 150 h.p. versions powers the C.A.S.A.-built Bücker 131 and various H.M. light aircraft built by AISA. The E.N.M.A. Tigre G-5 powers the AISA I-115 trainer, and the AISA AVD-12 and Dornier Do 25 liaison aircraft. The E.N.M.A. Sirio radial powers the C.A.S.A. 201 Alcotan twin-engined commercial monoplane. The E.N.M.A. Beta radial powers the C.A.S.A. 202 Halcón twin-engined commercial monoplane and the Hispano HA-100-E1 Triana single-engined advanced trainer.

E.N.M.A. have the licence to build the Turbomeca Marboré II turbojet engine, and are responsible for overhauling the Turbomeca-built Artouste turbines imported by Aerotecnica for their helicopters.

THE E.N.M.A. SIRIO S2.

Official designation: 7.E-C20-500.

TYPE.—Seven-cylinder radial air-cooled, supercharged.

CYLINDERS.—Bore 150 mm. (5.9 in.). Stroke 145 mm. (5.75 in.). Capacity 17.93 litres (1,090 cub. in.). Compression ratio 6 : 1. Finned steel barrels with cast aluminium head screwed on. One inlet and one sodium-cooled exhaust valve per cylinder.

PISTONS.—Aluminium alloy. Floating gudgeon-pins. Three compression rings and two scraper rings.

CONNECTING RODS.—Master rod and six auxiliary connecting-rods carried on wrist pins. Special bronze little-end bearings.

CRANKSHAFT.—Single-throw shaft in two halves clamped and keyed together. On two roller bearings and one ball bearing for the tail shaft.

CRANKCASE.—Main case and compressor casing made in one piece, from "RR-53" light alloy.

VALVE GEAR.—Fully-enclosed valve gear comprising push-rods, rocker-arms, etc. with pressure lubrication and scavenge return.

CARBURATION.—One double down-draught TM Type CAS-100 MM carburettor.

SUPERCHARGER.—Centrifugal type with a gear ratio of 7.85 : 1.

FUEL GRADE.—87 octane minimum.

LUBRICATION.—Four pumps in the lower part of the rear crankcase, one pressure and three scavenge pumps. A filter at the outlet of the pressure pump is easily accessible for cleaning. Oil pressure 3-5 kg./cm.² (42.67-71.12 lb./sq. in.).

IGNITION.—Two FEMSA magnetos, type MAQ 71-1 with automatic advance on right-hand side, type MAQ 71-2 on left-hand side. Two AC-LS-87, Lodge type RS-19-2RS or KLG type RC-19/1R plugs per cylinder. Armoured ignition. Shielded harness.

AIRSCREW DRIVE.—Direct drive, using standard SAE 40 shaft.

ACCESSORIES.—Fuel pump, airscrew control, tachometers, connections for temperature and pressure gauges for fuel, oil, etc., mounted on the accessories casing. QBI vacuum pump, LOP hydraulic pump, and FEMSA Marelli type D.N.V.1 electrical generator mounted on a gearbox attached to the lower portion of the accessories casing and mechanically-driven from the crankshaft.

STARTING.—FEMSA type AR-152-1 electric starter.

MOUNTING.—Seven flexible mounting points situated symmetrically around the compressor casing.

DIMENSIONS.—
Overall diameter 1,120 mm. (44.1 in.).
Length 1,161 mm. (45.71 in.).
Frontal area 0.985 m.² (10.6 sq. ft.).

WEIGHT.—
356 kg. (785 lb.).

PERFORMANCE.—
Max. output for 5 min. only 500 h.p. at 2,300 r.p.m.
Normal output 440 h.p. at 2,100 r.p.m. at 2,100 m. (6,890 ft.).
Max. cruising output 330 h.p. at 1,960 r.p.m. at 3,500 m. (11,500 ft.).
Recommended cruising output 310 h.p. at 1,900 r.p.m. at 3,600 m. (11,800 ft.).

CONSUMPTIONS.—
Normal output: fuel 260 gr. (0.573 lb.). per h.p./hr., oil 12 gr. (.0264 lb.) per h.p./hr.
Cruising: fuel 225 gr. (0.496 lb.) per h.p./hr., oil 8 gr. (.0176 lb.) per h.p./hr.

THE E.N.M.A. BETA B-4.

Official designation: 9.E-C.29-775.

TYPE.—Nine-cylinder radial air cooled, supercharged.

CYLINDERS.—Bore 155.5 mm. (6.1 in.). Stroke 174.6 mm. (6.8 in.). Capacity 29.85 litres (1,820 cub. in.). Compression ratio 6.4 : 1. Finned steel barrels with cast aluminium-alloy heads screwed on. One inlet and one sodium-cooled exhaust valve per cylinder.

CRANKSHAFT.—Single-throw shaft in two pieces clamped and keyed together. Shaft runs on two roller bearings and one ball thrust bearing.

CRANKCASE.—Made in two portions from "RR-56" light alloy forgings.

VALVE GEAR.—Fully-enclosed, with pressure lubrication and scavenge return.

CARBURATION.—One IRZ Model B-885 four-barrel down-draught carburettor.

SUPERCHARGER.—Centrifugal type. Gear ratio 8.31 : 1.

FUEL GRADE.—87 Octane minimum.

LUBRICATION.—One pressure and one scavenge pump. Oil pressure 3.5-5.5 kg./cm.² (49-77 lb./sq. in.).

IGNITION.—Two FEMSA MAQ-9, type GN9-12D-F1-R magnetos mounted on the accessory casing. Two ISA, Bosch, AC, KLG, Beru or similar plugs per cylinder. Shielded harness.

AIRSCREW DRIVE.—Direct drive, using standard SAE 40 shaft.

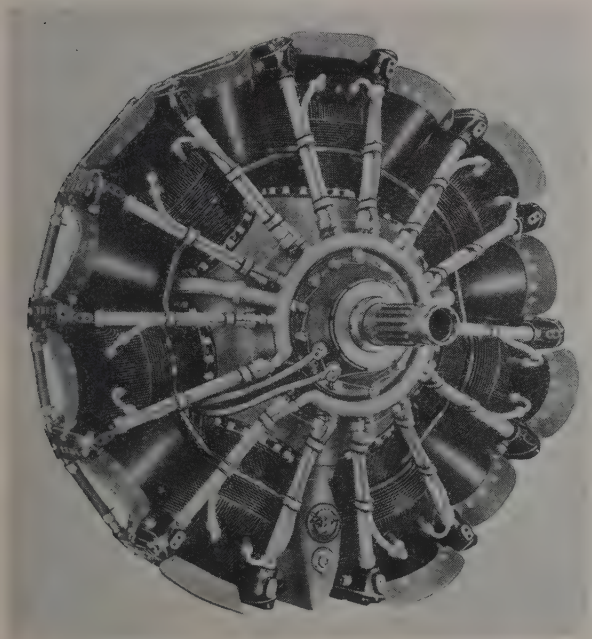
ACCESSORIES.—Fuel pump and airscrew control mounted above the accessories casing. Tachometers, connections for temperature and pressure gauges for fuel, oil etc., mounted on the accessories casing. QBI vacuum pump, LOP hydraulic pump, Nova type NA04 or similar pressure pump and FEMSA Marelli type D.N.V.1 electrical generator mounted on a gearbox attached to the lower portion of the accessories casing and mechanically-driven from the crankshaft.

STARTING.—FEMSA type AR-152-1 electric starter.

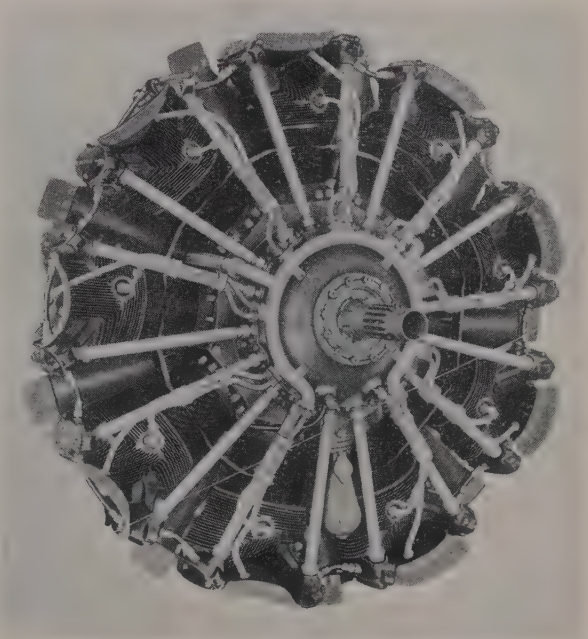
MOUNTING.—Nine flexible mounting points situated symmetrically around the compressor casing.

DIMENSIONS.—
Diameter 1,386 mm. (54.6 in.).
Length 1,166 mm. (45.9 in.).
Frontal area 1.5 m.² (16.15 sq. ft.).

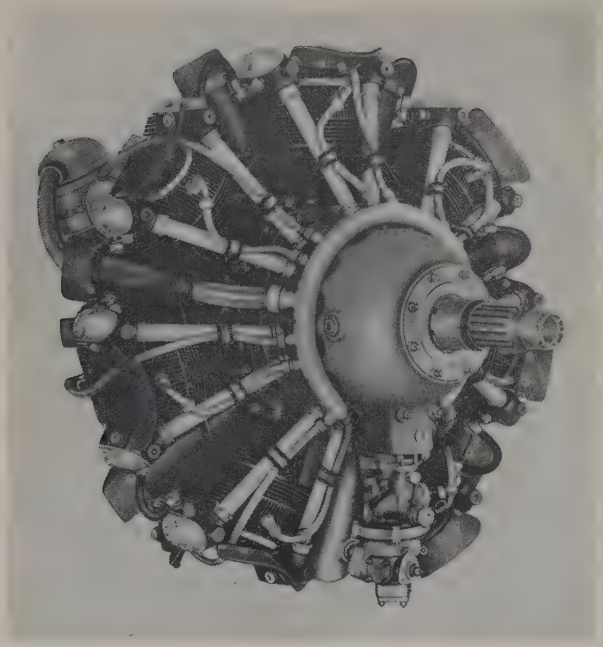
WEIGHT.—
485 kg. (1,070 lb.).

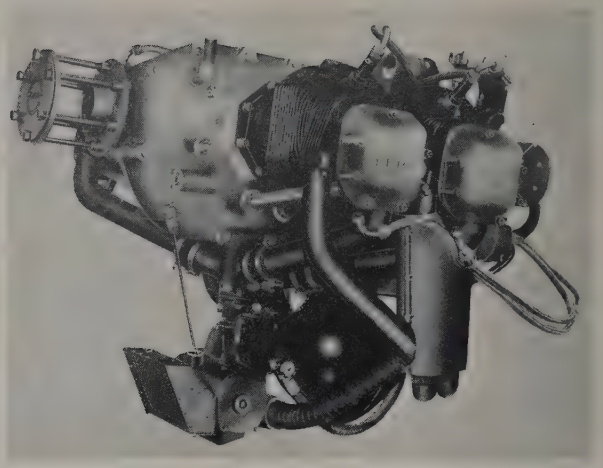


The 500 h.p. E.N.M.A. Sirio S2 radial engine.



The 775 h.p. E.N.M.A. Beta B-4 radial engine.





On the left, the 275 h.p. E.N.M.A. Alcion A-1 radial engine and, above, the 93 h.p. E.N.M.A. Flecha F-IV-1 flat-four engine.

PERFORMANCE.—
Take-off output 775 h.p. at 2,200 r.p.m.
Normal output 750 h.p. at 2,100 r.p.m. at 2,900 m. (9,510 ft.).
Cruising output 550 h.p. at 1,600 r.p.m. at 3,000 m. (9.840 ft.).
CONSUMPTIONS.—
Fuel (cruising) 250 gr./h.p./hr. (.55 lb./h.p./hr.).
Oil (cruising) 8 gr./h.p./hr. (.0176 lb./h.p./hr.).

THE E.N.M.A. ALCION A-1.

Official designation: 7.E-CR.15-275.

The E.N.M.A. Alcion, which is being developed for both horizontal and vertical installations, is a seven-cylinder geared and supercharged air-cooled radial. The following are its principal particulars :—

TYPE.—Seven-cylinder radial air-cooled, geared and supercharged.
CYLINDERS.—Bore 110 mm. (4.33 in.). Stroke 110 mm. (4.33 in.). Capacity 7.317 litres (446 cub. in.). Compression ratio 6.5 : 1. Steel cylinders with "Y" alloy heads screwed on.
PISTONS, CONNECTING RODS, CRANKSHAFT.—Similar to those of Sirio S2.
CRANKCASE.—Separate light alloy casings for the reduction gear, transmission, cylinders (in two portions), compressor and accessories.
VALVE GEAR.—Similar to that of Sirio S2.
CARBURATION.—Updraught carburettor.
SUPERCHARGER.—Centrifugal. Gear ratio 7.979 : 1.
FUEL GRADE.—100 Octane.
IGNITION.—Two FEMSA Models MAQ 71-1 and MAQ 71-2 magnetos with automatic advance. Two 18 mm. AC-L5-87 sparkplugs per cylinder.
LUBRICATION.—Pressure type. Four pumps. Oil pressure 2.5-5.5 kg./cm.² (49.78-78.23 lb./sq. in.).
AIRSCREW REDUCTION GEAR.—Planetary. Gear ratio 0.66 : 1. Standard SAE 20 shaft.
ACCESSORIES.—BS-6000.SS fuel pump, Nova type NA04 pressure pump, LOP hydraulic pump and FEMSA Marelli type DNA-301-2 electric generator mounted on the accessories casing. Airscrew control mounted on the lower portion of the reduction gear casing.
STARTING.—FEMSA type AR-154-1 electric starter.
MOUNTING.—Seven flexible mounting points situated symmetrically around the compressor casing.
DIMENSIONS.—
Diameter 850 mm. (33.46 in.).
Length 1,166 mm. (45.90 in.).
Frontal area 0.57 m.² (6.14 sq. ft.).
WEIGHT.—
225 kg. (495 lb.).
PERFORMANCE.—
Take-off output 275 h.p. at 3,000 r.p.m.
Normal output 250 h.p. at 2,800 r.p.m. at 1,500 m. (4,920 ft.).
Cruising output 175 h.p. at 2,400 r.p.m. at 2,000 m. (6,560 ft.).
CONSUMPTIONS.—
Fuel (cruising) 210 gr./h.p./hr. (.46 lb./h.p./hr.).
Oil (cruising) 8 gr./h.p./hr. (.0176 lb./h.p./hr.).

THE E.N.M.A. FLECHA F-IV-1.

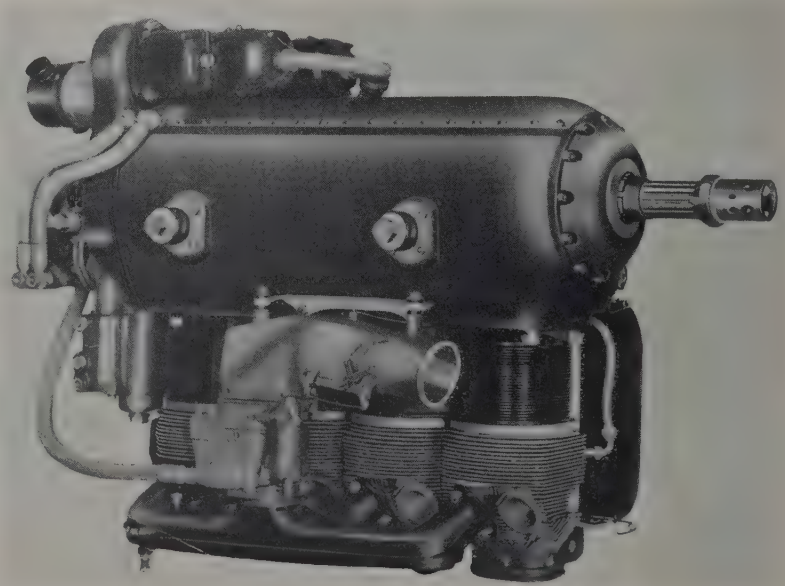
The Flecha is an air-cooled flat-four engine which is being built in prototype form. The following are its principal particulars.

TYPE.—Four-cylinder horizontally-opposed air-cooled.
CYLINDERS.—Bore 105 mm. (4.1 in.). Stroke 100 mm. (3.9 in.). Capacity 3.46 litres (211 cub. in.). Compression ratio 7 : 1. Steel cylinders with light alloy heads.
CRANKSHAFT.—One-piece steel forging with four throws and running on three bearings.
CRANKCASE.—Aluminium alloy case in two parts, split in vertical plane.
VALVE GEAR.—One inlet and one exhaust valve per cylinder.
CARBURATION.—"1RZ," Stromberg NA-SE A1 or similar carburettor. BS-6000 SS fuel pump.
FUEL GRADE.—87 Octane minimum.
IGNITION.—Two FEMSA type ME.41-1 and ME.41-2 magnetos. Two Champion C.24S, AC type LS.86 or similar spark-plugs per cylinder. Order of firing 1-3-2-4. Shielded harness.
LUBRICATION.—Pressure type. Maximum pressure 4 kg./cm.² (56.8 lb./sq. in.) minimum pressure 1.5 kg./cm.² (21.3 lb./sq. in.).
AIRSCREW DRIVE.—Direct drive, using standard SAE 1 shaft.
ACCESSORIES.—FEMSA type DNA-301-1 300-watt 24-volt generator.
STARTING.—FEMSA type AR-154-1 electric starter.
MOUNTING.—Four flexible mounting points, two above and two below the crankcase.
DIMENSIONS.—
Width 804 mm. (31.64 in.).
Length 809 mm. (31.84 in.).
Height 728 mm. (28.65 in.).
WEIGHT.—
100 kg. (220 lb.).
PERFORMANCE.—
Nominal output 93 h.p. at 2,600 r.p.m.
CONSUMPTIONS.—
Fuel (cruising) 230 gr./h.p./hr. (.507 lb./h.p./hr.).
Oil (cruising) 3-4 gr./h.p./hr. (.0066-.0088 lb./h.p./hr.).

THE E.N.M.A. TIGRE G-IV-A5 AND G-IV-B5.

Official designations: (G-IV-A5) G5, 4.(L)-00-125; (G-IV-B5) G5, 4.(L)-00-150.

TYPE.—Four-cylinder in-line inverted air-cooled.
CYLINDERS.—Bore 120 mm. (4.72 in.). Stroke 140 mm. (5.512 in.). Capacity 6.3 litres (386.3 cub. in.). Compression ratio 6.33 : 1. Cast Y-alloy cylinder heads. Forged and machined chrome-molybdenum steel barrels. Heads screwed on to barrels. Aluminium-bronze inlet valve seats. Austenitic steel exhaust valve seats.
PISTONS.—Aluminium - alloy. Fully - floating gudgeon-pins.
CONNECTING RODS.—Forged aluminium-alloy Copper-lead big-end bearings. Special bronze small-end bearings.
CRANKSHAFT.—Forged and machined chrome-nickel steel four-throw shaft on four copper-



The 125 h.p. E.N.M.A. Tigre G-IV-A5 four-cylinder engine.

lead main bearings and one ball thrust bearing.

CRANKCASE.—Main case of Elektron on the G-IV-A and of "RR-53" alloy on the G-IV-B. Rear casing of Elektron.

CARBURATION.—TM type CAT-60 MM inverted carburettor.

FUEL GRADE.—80 Octane.

IGNITION.—Two FEMSA magnetos, type MVE.4-1 and MVE.4-2.

LUBRICATON.—Pressure by five pumps driven from rear end of camshaft. Triple oil filter. Oil pressure 3-5 kg./cm.^{2} (42.67-71.12 lb./sq. in.).

ACCESSORIES.—Type CS-6000 SS-1 fuel pump and FEMSA type DNA 301-2 electric generator mounted on accessories casing.

STARTING.—FEMSA type AR-154-1 electric starter.

DIMENSIONS.—
Length 1,211 mm. (47.67 in.).
Width 400 mm. (15.76 in.).
Height 757 mm. (29.82 in.).
Frontal area 0.30 m.^{2} (3.23 sq. ft.).

WEIGHT (G-IV-A5).—
137 kg. (302 lb.).

WEIGHT (G-IV-B5).—
146 kg. (322 lb.).

PERFORMANCE (G-IV-A5).—
Normal output 125 h.p. at 2,000 r.p.m.
Max. cruising output 100 h.p. at 1,850 r.p.m.
Recommended cruising output 80 h.p. at 1,700 r.p.m.

PERFORMANCE (G-IV-B5).—
Normal output 150 h.p. at 2,300 r.p.m.
Max. cruising output 120 h.p. at 2,140 r.p.m.
Recommended cruising output 95 h.p. at 1,950 r.p.m.

CONSUMPTIONS.—
At cruising output (70% power).
Fuel 225 gr. (.496 lb.) per h.p./hr.
Oil (G-IV-A5) 8 gr. (.0176 lb.) per h.p./hr.
Oil (G-IV-B5) 9 gr. (.0198 lb.) per h.p./hr.

UNITED STATES OF AMERICA

CONTINENTAL

THE CONTINENTAL MOTORS CORPORATION, AIRCRAFT ENGINE DIVISION.

HEAD OFFICE: 205, MARKET STREET, MUSKEGON, MICH.

WORKS: MUSKEGON AND DETROIT, MICH.

President and General Manager: C. J. Reese.

Vice-President in charge of Sales and Service, Aircraft Division: D. H. Hollowell.

Chief Engineer, Aircraft Division: W. A. Wiseman.

Treasurer: H. W. Vandeven.

In 1928, Continental Motors Corporation, one of the largest automobile engine manufacturers in the World, produced its first aero-engine, a sleeve-valve radial air-cooled incorporating the Argyll (Burt-McCollum) patents, which had been purchased by the Corporation from the British Argyll Company in 1925.

In 1931 the 38 h.p. A40 flat-four was put on the market. This was followed by the A50, A65, A75 and A80 engines.

The current range of Continental light aircraft engines includes the A65-8, C85-12, C90-12F, O-300-A and B, GO-315-A, O-470-E, G, H, J, K, L and M, IO-470-C, O-470-2, GSO-526-A and FSO-526-A (helicopter engine).

Continental Aviation and Engineering Corporation, a subsidiary of Continental Motors Corporation, holds a licence to manufacture the French Turbomeca range of gas-turbine engines. Details of Continental gas-turbine engines will be found in Part 1 of this Section.

THE CONTINENTAL A65 SERIES.

Basic engine of the A65 series is the A65-8F. The A65-12F is similar except for the addition of a Delco-Remy starter and 12v. 20 amp. generator. These items increase the height to 21.22 in. (539 mm.), length to 31.26 in. (794 mm.) and weight to 197 lb. (89 kg.).

TYPE.—Four-cylinder horizontally-opposed air-cooled.

CYLINDERS.—Bore $3\frac{7}{8}$ in. (98.43 mm.). Stroke $3\frac{5}{8}$ in. (92 mm.). Capacity 171 cub. in. (2.8 litres). Compression ratio 6.3 : 1. Heat-treated cast aluminium-alloy heads screwed and shrunk on to forged-steel barrels. Valve-seat inserts and spark-plug bushings of aluminium-bronze. Bronze valve-guides.

PISTONS.—Lo-Ex duralumin-alloy. Trunk type. Full floating gudgeon-pin located by end-plugs. Two compression and one scraper rings above gudgeon-pins.

CONNECTING RODS.—Forged steel. Split big-ends carry replaceable thin-shell steel-backed Tri-metal bronze bearings. Bronze bushings pressed into gudgeon-pin ends.

CRANKSHAFT.—One-piece, four-throw, chromium-nickel-molybdenum steel forging, drilled for lubrication, runs in three steel-backed Tri-metal bronze bearings, one of which is at middle of shaft.

CRANKCASE.—Two-piece heat-treated aluminium casting divided at vertical lengthwise plane through crankshaft. Rigid transverse webs carry main bearings and camshaft journals. Rawhide seal prevents oil leakage at airscrew. Four engine-mounting bosses for $\frac{3}{8}$-in. (9.5 mm.) bolts at rear of crankcase.

VALVE GEAR.—One hardened steel inlet-valve and one heat-resisting austenitic exhaust-valve per cylinder, each operated through rocker-arm, ball-ended push-rod and Wilcox-Rich hydraulic tappet, all sealed to prevent external oil leakage. Cast Preferall camshaft has six hardened cams (intake cams are common to opposing cylinders). Three hardened journals and overhung eccentric at airscrew end to run fuel pump.

INDUCTION SYSTEM.—Single up-draught Marvel MA-3SPA carburettor supplies mixture to cast-aluminium X-manifold with exhaust-heated hot-spot. Steel intake pipes connect manifold to intake ports.

IGNITION.—Dual magnetos either Eisemann LA-4, Case 4-CAM-E or Scintilla S4-RN-20.

LUBRICATION.—Oil at 30 lb./sq. in. (2.11 kg./cm.^{2}) passes through oil tubes in crankshaft to crank-pins and also passes through tappet, push-rod and rocker-arm to rocker-arm bushing and valve-tip. Valve-stem and guide lubricated by splash. Oil returned to crankcase by way of push-rod housings. Pressure filter and relief-valve in crankcase.

AIRSCREW DRIVE.—R.H. tractor. Direct. No. 0 S.A.E. taper.

DIMENSIONS, WEIGHTS AND PERFORMANCE.—See Table.

THE CONTINENTAL C85 SERIES.

The C85 Series is identical to the earlier C75 Series except that the C85 carburettor has a $1\frac{3}{8}$ in. (35 mm.) venturi as compared with $1\frac{5}{16}$ in. (33.2 mm.) for the C75 and larger main metering jet. The normal rated r.p.m. of the C85 is increased from 2,275 to 2,575 and the rated output is increased from 75 to 85 h.p.

The Series 8 engine has a tapered crankshaft while the 8F has a flanged shaft. The Series 12 has the addition of Delco-Remy starter and generator drives in the accessory case.

General constructional details are similar to those of the A65 Series. For other details see Table.

THE CONTINENTAL C90 SERIES.

The C90 Series includes the C90-8F which has a flanged crankshaft but does not have provisions for installing either a starter or generator, and the C90-12F which has a flanged crankshaft and Delco-Remy starter and generator.

This Series differs from the C85 Series in having cylinders with a slightly larger bore. Otherwise the two engines are constructionally the same. The C90 Series engines have an approved take-off rating of 95 h.p. at 2,625 r.p.m. For other details see Table.

THE CONTINENTAL O-300-A and B.

The O-300 is a six-cylinder engine which uses the cylinders of the C90 Series. Equipment includes a Marvel MA-3SPA carburettor and Bendix Scintilla S6LN-21 magneto. General constructional details are otherwise similar to those of the C90 Series.

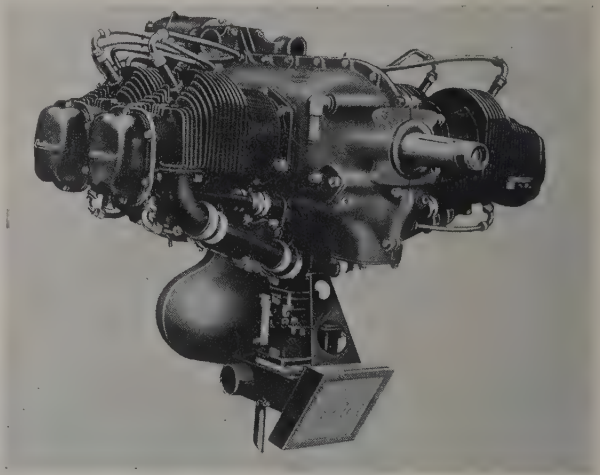
Both A and B Series engines are identical except that there is provision for a controllable airscrew in the latter.

THE CONTINENTAL GO-300-A and B.

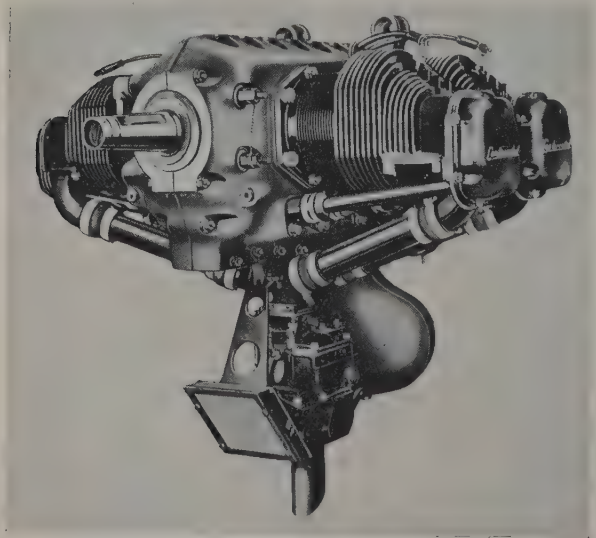
The GO-300 is generally similar to the O-300 except that it has a gear-driven airscrew shaft. As in the basic engine, the B Series has provision for a controllable airscrew.

THE CONTINENTAL GO-315-A.

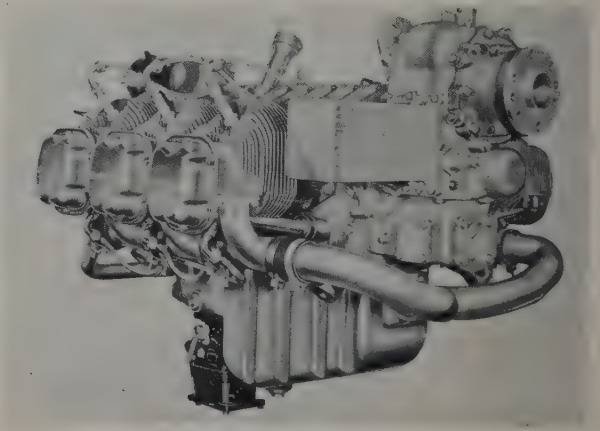
The GO-315-A is a four-cylinder geared engine which makes use of the larger 5×4 in. cylinders of O-470 Series. The airscrew gear ratio is .688 : 1. This engine has a take-off output of 175 h.p. at 3,200 crankshaft r.p.m.



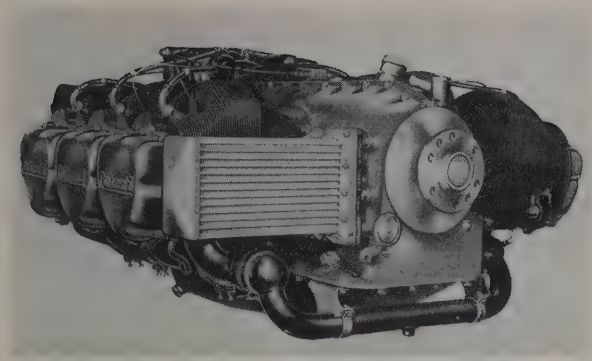
The 85 h.p. Continental C85 Series engine.



The 65 h.p. Continental A65 Series engine.



The 175 h.p. Continental GO-300-A engine.



The 240 h.p. Continental O-470-M six-cylinder horizontally-opposed air-cooled engine.

THE CONTINENTAL O-470 SERIES.

Engines in the O-470 series are all basically similar. Following are the main differences in the various versions in current use :—

O-470-B. As detailed description below, but with inclined valves and 8 : 1 compression ratio. One Bendix-Stromberg PSD-5C updraught carburettor at rear of engine. Develops 240 h.p. at 2,600 r.p.m. for take-off and maximum continuous cruise. 91/96 octane fuel. Weight 450 lb. (204 kg.).

O-470-E. As detailed description below, but one Bendix-Stromberg PSD-5C updraught carburettor. Develops 225 h.p. at 2,600 r.p.m. Weight 390 lb. (177 kg.).

O-470-G. As detailed description below, but with shell moulded cylinder heads, different mounting and Bendix-Stromberg PSH-5BD automatic altitude-compensating updraught carburettor. Develops 240 h.p. at 2,600 r.p.m. 91/96 octane fuel. Weight 432 lb. (196 kg.).

O-470-H. As detailed description below, but with shell moulded cylinder heads, different mounting and extended airscrew shaft. Develops 240 h.p. at 2,600 r.p.m. 91/96 octane fuel. Weight 472 lb. (214 kg.).

O-470-J. As detailed description below. Develops 225 h.p. at 2,550 r.p.m. Weight 381 lb. (173 kg.).

O-470-K. Description below refers to this model.

O-470-L. As detailed description below, but with special intake manifold case enabling carburettor to be installed approximately 4 in. (102 mm.) forward of position used on O-470-K. This requires a change in oil sump to provide clearance.

O-470-M. As detailed description below, but with shell moulded cylinder heads and different mounting. Develops 240 h.p. at 2,600 r.p.m. 91/96 octane fuel. Weight 410 lb. (186 kg.).

The following description refers specifically to the O-470-K, but is generally applicable to all versions :—

TYPE.—Six-cylinder horizontally-opposed air-cooled.

CYLINDERS.—Bore 5 in. (127 mm.). Stroke 4 in. (101.6 mm.). Swept volume 471 cub. in. (7.5 litres). Compression ratio 8 : 1. Forged steel barrels with integral cooling fins. Heat-treated cast aluminium alloy heads screwed and shrunk on to barrels.

PISTONS.—Aluminium. Three rings, two compression and one oil control. Steel gudgeon-pins with circlip retainers.

CONNECTING RODS.—Forged steel. Trimetal bronze replaceable type big-end bearings bronze bush little-ends.

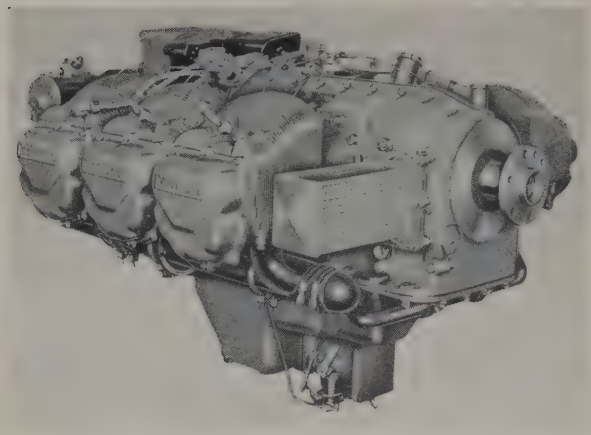
CRANKSHAFT.—One-piece six-throw chrome-nickel-molybdenum steel forging. Outer surfaces nitrided. Four 6th order counter-weights attached to shaft. Five bearings of replaceable shell type.

CRANKCASE.—Two-piece heat-treated aluminium casting divided at vertical lengthwise plane through crankshaft, with integral cast accessory section.

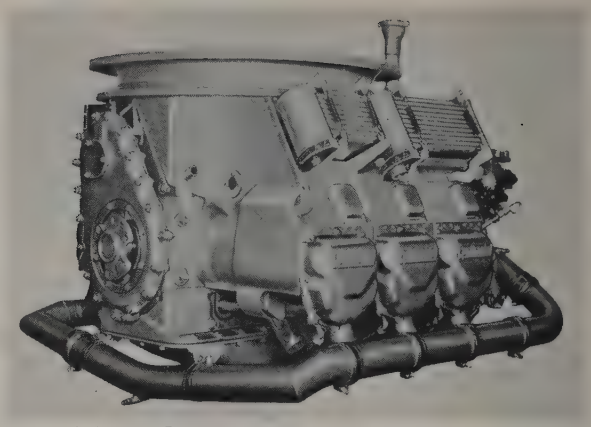
VALVE GEAR.—Two poppet-type valves per

THE CONTINENTAL HORIZONTALLY-OPPOSED ENGINES

Engine Model	No. of Cylinders	Bore and Stroke	Swept Volume	Power Ratings		Comp. Ratio	Dry Weight	Dimensions			Fuel Grade
				Take-off	Max. cont.			Length	Width	Height	
A65-8F	4	$3\frac{7}{8} \times 3\frac{5}{8}$ in. (98.4 × 92 mm.)	171 cub. in. (2.80 litres)	65 h.p. at 2,300 r.p.m.	65 h.p. at 2,300 r.p.m.	6.3 : 1	173 lb. (78.5 kg.)	28.97 in. (736 mm.)	31.5 in. (800 mm.)	20.34 in. (517 mm.)	80/87 Octane
C85-12F	4	$4\frac{1}{16} \times 3\frac{5}{8}$ in. (103.2 × 92 mm.)	188 cub. in. (3.08 litres)	85 h.p. at 2,575 r.p.m.	85 h.p. at 2,575 r.p.m.	6.3 : 1	207 lb. (93.9 kg.)	31.26 in. (794 mm.)	31.5 in. (800 mm.)	21.22 in. (539 mm.)	80/87 Octane
C90-12F	4	$4\frac{1}{16} \times 3\frac{7}{8}$ in. (103.2 × 98.4 mm.)	201 cub. in. (3.28 litres)	95 h.p. at 2,625 r.p.m.	90 h.p. at 2,475 r.p.m.	7.0 : 1	207 lb. (93.9 kg.)	31.26 in. (794 mm.)	31.5 in. (800 mm.)	21.22 in. (539 mm.)	80/87 Octane
O-300-A and -B	6	$4\frac{1}{16} \times 3\frac{7}{8}$ in. (103.2 × 98.4 mm.)	301 cub. in. (4.9 litres)	145 h.p. at 2,700 r.p.m.	145 h.p. at 2,700 r.p.m.	7.0 : 1	277 lb. (125.5 kg.)	36.38 in. (924 mm.)	31.5 in. (800 mm.)	22.53 in. (572 mm.)	80/87 Octane
GO-300-A and -B	6	$4\frac{1}{16} \times 3\frac{7}{8}$ in. (103.2 × 98.4 mm.)	301 cub. in. (4.9 litres)	175 h.p. at 3,200 r.p.m.	175 h.p. at 3,200 r.p.m.	7.3 : 1	312 lb. (141.5 kg.)	39.12 in. (994 mm.)	31.5 in. (800 mm.)	27.62 in. (703 mm.)	80/87 Octane
O-470-K and -L	6	5 × 4 in. (127 × 101.6 mm.)	471 cub. in. (7.6 litres)	230 h.p. at 2,600 r.p.m.	230 h.p. at 2,600 r.p.m.	7.0 : 1	404 lb. (183 kg.)	36.03 in. (915 mm.)	33.58 in. (853 mm.)	27.75 in. (705 mm.)	80/87 Octane
O-470-M	6	5 × 4 in. (127 × 101.6 mm.)	471 cub. in. (7.6 litres)	240 h.p. at 2,600 r.p.m.	240 h.p. at 2,600 r.p.m.	8.0 : 1	410 lb. (186 kg.)	43.3 in. (1,100 mm.)	33.58 in. (853 mm.)	19.6 in. (498 mm.)	91/96 Octane
IO-470-C	6	5 × 4 in. (127 × 101.6 mm.)	471 cub. in. (7.6 litres)	250 h.p. at 2,600 r.p.m.	250 h.p. at 2,600 r.p.m.	8.0 : 1	432 lb. (196 kg.)	37.56 in. (954 mm.)	33.58 in. (852 mm.)	26.81 in. (681 mm.)	91/96 Octane
O-470-2	6	5 × 4 in. (127 × 101.6 mm.)	471 cub. in. (7.6 litres)	265 h.p. at 2,600 r.p.m.	250 h.p. at 2,600 r.p.m.	7.0 : 1	474 lb. (214 kg.)	37.7 in. (960 mm.)	33.6 in. (855 mm.)	30.7 in. (780 mm.)	100/130-Octane
O-470-15	6	5 × 4 in. (127 × 101.6 mm.)	471 cub. in. (7.6 litres)	213 h.p. at 2,600 r.p.m.	190 h.p. at 2,300 r.p.m.	7.0 : 1	405 lb. (184 kg.)	44.75 in. (1,137 mm.)	33.4 in. (850 mm.)	26.61 in. (676 mm.)	80/87 Octane
GSO-526-A	6	5.125 × 4.25 in. (130 × 108 mm.)	526 cub. in. (8.64 litres)	340 h.p. at 3,100 r.p.m.	300 h.p. at 3,000 r.p.m.	6.0 : 1	549 lb. (249 kg.)	52.28 in. (1,328 mm.)	34.68 in. (881 mm.)	25.07 in. (637 mm.)	100/130 Octane
FSO-526-A (Helicopter)	6	5.125 × 4.25 in. (130 × 108 mm.)	526 cub. in. (8.64 litres)	270 h.p. at 3,200 r.p.m.	270 h.p. at 3,000 r.p.m.	6.0 : 1	575 lb. (261 kg.)	47.69 in. (1,221 mm.)	33.64 in. (855 mm.)	24.73 in. (628 mm.)	91/96 Octane



The 250 h.p. Continental IO-470-C engine.



The 270 h.p. Continental FSO-526-A helicopter engine.

cylinder, one steel inlet and one steel exhaust with stellite seat. Camshaft gear-driven from crankshaft in lower part of crankcase.

INDUCTION.—Marvel Schebler MA-4-5 horizontal pressure-type carburettor.

FUEL.—80/87 Octane.

IGNITION.—Two Bendix-Scintilla Type S6RN-25 magnetos on top of accessory section. Two Champion RHD-39N spark-plugs per cylinder. Shielded ignition harness.

LUBRICATION.—Pressure type. Harrison oil-cooler on front of crankcase. Oil filter in crankcase. One impeller type pump. Oil pressure 30 - 60 lb./sq. in. (2.1-4.2 kg./cm.²).

AIRSCREW DRIVE.—R.H. drive. Direct. Flanged airscrew shaft. Provision for Hartzell constant-speed airscrew.

ACCESSORIES.—Delco-Remy generator on accessory section. Drives for vacuum pump and tachometer.

STARTING.—Delco-Remy electric starter.

MOUNTING.—Four mounting points, one at each lower corner of crankcase

DIMENSIONS, WEIGHTS AND PERFORMANCE.—See Table.

THE CONTINENTAL IO-470-C.

The IO-470-C is similar in every way to the basic O-470 series, except that it features a Continental-developed fuel injection system instead of the usual induction system with carburettor.

THE CONTINENTAL O-470-2.

The O-470-2 is a supercharged version of the O-470. It is fitted with a belt-driven centrifugal blower with a ratio of 10.36 : 1 and a Bendix-Stromberg PSH-5CD horizontal pressure carburettor. In most other respects the engine is similar to the O-470-K.

THE CONTINENTAL GSO-526-A.

The GSO-526-A is a geared and supercharged six-cylinder engine which is basically and constructionally similar to the O-470 Series but has larger cylinders of 5.125 in. (130 mm.) bore and 4.25 in. (108 mm.) stroke. The airscrew gear ratio is .688 : 1. For further details see Table.

THE CONTINENTAL FSO-526-A.

The FSO-526-A is arranged for helicopter use. It is fitted with fan-cooling, with a single shrouded gear-driven fan driven off the front end of the crankshaft and serving both rows of cylinders. For other details see table.

FRANKLIN

AIRCOOLED MOTORS, INC.

HEAD OFFICE AND WORKS : SYRACUSE 8, N.Y.

President and General Manager : C. F. B. Roth.

Sales Manager : C. H. Bennum.

Service Manager : V. J. Mecca.

Chief Engineer : J. D. Cregan.

Aircooled Motors, Inc. produced the first of its very successful series of light horizontally-opposed air-cooled engines in 1938. Up to the outbreak of war it had placed on the market engines of four and six cylinders ranging in output from 65 to 150 h.p.

The current series of Franklin engines comprises a number of six-cylinder models covering a range of from 150 to 210 h.p.

THE FRANKLIN 335.

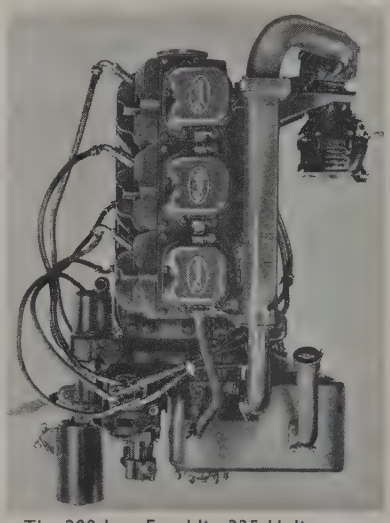
TYPE.—Six-cylinder, horizontally-opposed direct-drive air-cooled.

CYLINDERS.—Bore 4½ in. (114.3 mm.). Stroke 3½ in. (88.9 mm.). Capacity 335 cub. in. (5.5 litres). Compression ratio 7.0 : 1. One-piece aluminium-alloy with removable iron liner. Attached to crankcase by integral hold-down flange and studs and nuts.

PISTONS.—Trunk - type, aluminium - alloy permanent-mould. Two compression and one oil ring per piston. Fully-floating piston-pins.

CRANKSHAFT.—One-piece six-throw steel forging with SAE standard airscrew shaft flange. Main and connecting rod bearings steel-backed and copper-lead faced.

CRANKCASE.—Aluminium-alloy in two halves split vertically. Detachable wet oil-sump underneath.



The 200 h.p. Franklin 335 Helicopter engine.

VALVE GEAR.—One overhead inlet and overhead exhaust valve per cylinder actuated by push-rods through rocker-arms with adjustable tappets. Wilcox-Rich hydraulic valve lifters provide zero-clearance regardless of engine temperature. Valve-gear totally enclosed and internally lubricated.

CARBURATION.—Marvel-Schebler float-type carburettor with altitude-control and idle cut-off, or Bendix-Stromberg pressure-type non-icing carburettor. Not optional.

ACCESSORIES.—Dual magnetos, float-type carburettor, 12-volt starter-generator, oil cooler. Fuel pump optional.

WEIGHT (with starter, generator and oil-cooler).—
320 lb. (145.3 kg.).

PERFORMANCE.—
Rated output : 150 h.p. at 2,600 r.p.m. (6A4-150-B3), 150 h.p. at 2,600 r.p.m. (6A4-165-B3), 165 h.p. at 2,800 r.p.m. and 210 h.p. at 3,100 r.p.m. (6A-335-A).

THE FRANKLIN 335 VERTICAL

Military designation: O-335.

TYPE.—Six-cylinder horizontally-opposed air-cooled. Engine operates in vertical position and is designed especially for a helicopter installation.

ACCESSORIES.—Dual magnetos, float or pressure-type carburettor, 12-volt starter, generator, fuel-pump, oil-cooler.

WEIGHT.—
310 lb. (140.7 kg.).

PERFORMANCE.—
Nett rated output : 200 h.p. at 3,100 r.p.m. (6V4-200-C32 and C33) using 90/91 octane fuel. 210 h.p. at 3,100 r.p.m. (6V4-335-A and B).

LYCOMING

THE LYCOMING DIVISION OF THE AVCO MANUFACTURING CORPORATION.

HEAD OFFICE : 550, SOUTH MAIN STREET, STRATFORD, CONNECTICUT.

WORKS : STRATFORD, CONN., AND WILLIAMSPORT, PENNSYLVANIA.

President and General Manager : James R. Kerr.

Vice-President, Engineering : Dr. Arthur Nutt.

Vice-President, Turbine Engineering : Dr. Anselm Franz.

Vice-President, Sales : H. Webster Crum.

Vice-President, Manager, Stratford Plant : Donald F. Turner.

Vice-President, Manager, Williamsport Plant : Floyd J. Bird.

Controller : C. J. Mason.

The Lycoming Division is the manufacturing division of the Avco Manufacturing Corporation.

It produces at its Williamsport plant the Lycoming series of horizontally-opposed air-cooled engines.

Licence production of the Curtiss-Wright R-1300 and R-1820 series of radial air-cooled engines was phased out in 1958 at the company's Stratford plant, which is now engaged mainly on development and production of the T53 and T55 shaft-turbines and a range of products in the aircraft accessory and electronic fields.

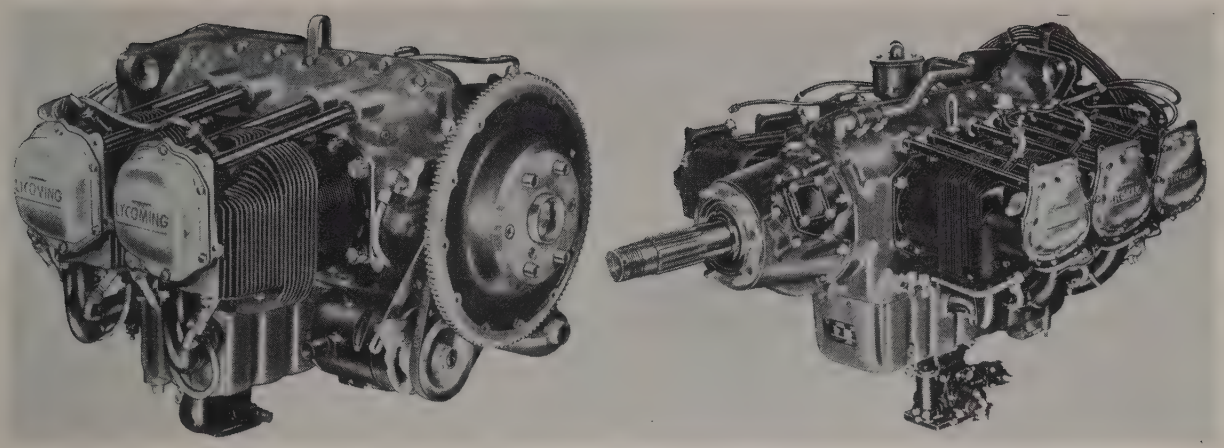
Details of the T53 and T55 will be found in Part I of this Section.

THE LYCOMING O-235 and O-290 SERIES.

The version of the O-290 Series engine in current production is the O-290-D2B, which differs from the preceding O-290-D2 by a compression ratio reduction from 7.50 to 7.00 : 1 and increased spark advance from 18° BTC to 25° BTC.

TYPE.—Four - cylinder horizontally - opposed air-cooled.

CYLINDERS.—Bore O-235-C 4⅜ in. (111 mm.). O-290-D 4⅞ in. (123.7 mm.). Stroke (both) 3⅞ in. (98.4 mm.). Aluminium-alloy head



On the left, the 150 h.p. Lycoming O-320 and, on the right, the 260 h.p. Lycoming GO-435-C2B engines.

screwed and shrunk onto steel barrel. Cylinder assemblies attached to crankcase by studs and nuts.

PISTONS.—Machined from aluminium-alloy forgings. O-235 piston has four rings, two compression, an oil regulator and an oil scraper. O-290 has three rings, two compression and one oil regulating. Fully-floating gudgeon-pins with aluminium-alloy retaining plugs.

CONNECTING RODS.—Forged steel. Copper-lead steel-backed precision type bearings. Bronze bushed little-ends.

CRANKSHAFT.—One-piece forged chrome nickel molybdenum steel four-throw shaft on four nitrided bearings.

CRANKCASE.—Aluminium-alloy casting split on vertical centre-line. Four precision copper-lead steel-backed main bearings.

VALVE GEAR.—Two valves per cylinder. Inlet valves of Silchrome No. 1, exhaust valves of AMS 5682 with Stellite-faced heads. Valve seats of AMS 5700 shrunk into head.

INDUCTION.—Marvel-Schebler MA-3A carburettor with manual altitude control and idle cut-off. Centre zone distribution chamber in oil sump.

IGNITION.—Two Bendix Scintilla S4LN magnetos, one driven through an impulse coupling.

LUBRICATION.—Full pressure wet sump type.

ACCESSORIES.—Starter, generator and tachometer drive. Starter is a Delco-Remy 12-volt automotive type located at front and cranks engine through a Bendix drive which engages with a gear integral with rear airscrew flange. Delco-Remy 12-volt automotive generator also at front of engine and driven by belt and pulley. Optional drives for fuel pump and vacuum pump can be supplied. Pads for these optional drives mounted on rear of engine.

DIMENSIONS, WEIGHTS AND PERFORMANCE.—See Table.

THE LYCOMING O-320 SERIES.

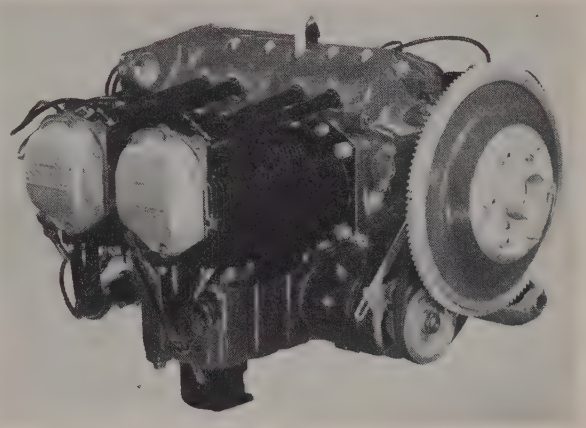
The O-320 is basically the same as the O-290-D2B except for an increase in cylinder bore to $5\frac{1}{8}$ in. (130 mm.) with a corresponding increase in swept volume to 319.8 cub. in. (5.2 litres), and use of a Marvel-Schebler MA-4SPA carburettor.

It is available in low-compression and high-compression versions for use with 80/87 or 91/96 octane fuels respectively.

For other details see Table.

THE LYCOMING O-340 and O-360 SERIES.

The O-340 is basically the same as the O-320 except for an increase in stroke to $4\frac{1}{8}$ in. (105 mm.) with a corresponding increase in swept volume to 340.4 cub. in. (5.58 litres), and use of the larger Marvel-Schebler MA-4-5 carburettor. The O-360, which has the highest rating of any four-cylinder engine certificated for production in America, is the same as the O-340 except for a further increase in stroke to $4\frac{3}{8}$ in (111 mm.), with a corresponding increase in swept volume to 361 cub. in. (5.92 litres). Both engines are available in low and high compression versions for use with 80/87 or 91/96 octane fuels respectively. For other details see Table.



The Lycoming O-235 and O-290 Series engine.

THE LYCOMING O-435 SERIES.

The O-435 Series includes direct-drive, geared and geared and supercharged models, details of which will be found in the Table. The O-435-KI is a direct-drive engine for horizontal helicopter installation while the VO-435-A1D (military designations 0-435-6A, -23B) is a helicopter engine for vertical installation. The GO-435-C2B is a geared-drive wet sump engine with an airscrew governor drive mounted on the left side of the airscrew reduction-gear housing. The GO-435-C2A is similar to the GO-435-C2B but provides dry sump operation for use with an external oil supply.

TYPE.—Six-cylinder horizontally-opposed air-cooled incorporating the major components of O-290.

CYLINDERS.—Bore $4\frac{7}{8}$ in. (123.7 mm.). Stroke $3\frac{7}{8}$ in (98.4 mm.).

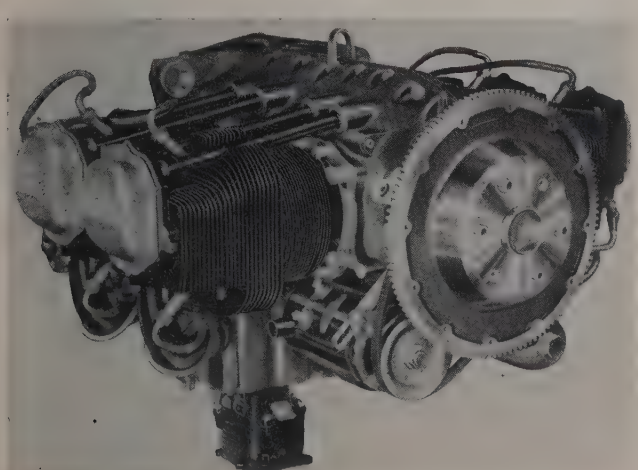
PISTONS.—Aluminium-alloy pistons with two compression and two oil control rings.

CONNECTING RODS.—H-section steel forgings with replaceable bearing inserts in big-ends and split bronze bushings in little-ends.

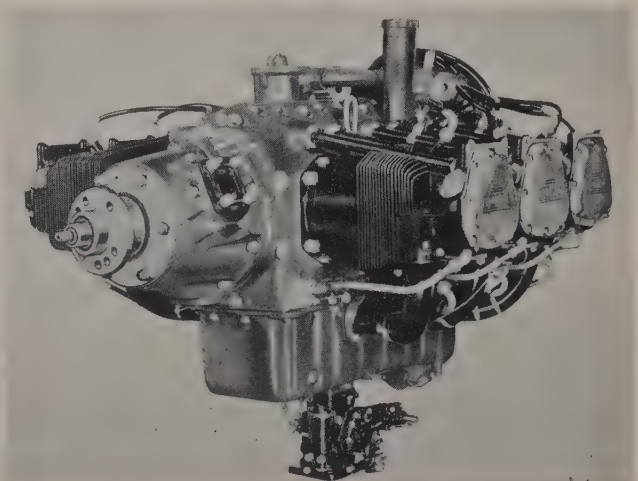
CRANKSHAFT.—Machined from chrome nickel molybdenum steel forging. All bearing surfaces nitrided.

CRANKCASE. — Aluminium-alloy casting split on the vertical centre-line. Additional ball-thrust bearing at forward end of case.

INDUCTION.—Marvel-Schebler MA-4-5 or



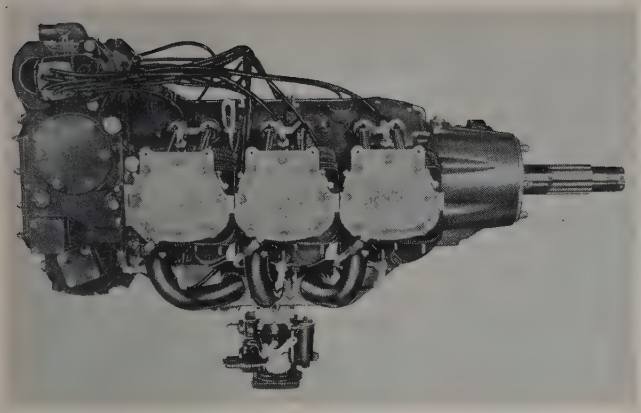
The Lycoming O-340 and 0-360 Series engine.

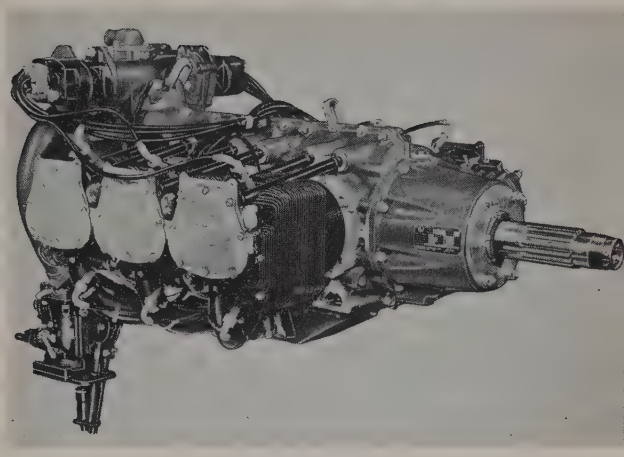


The Lycoming GO-480-F6 and G2D6 engine.

LYCOMING HORIZONTALLY-OPPOSED ENGINES.

Engine Model	No. of Cylinders	Rated output at Sea level	Capacity	Compression Ratio	Octane No.	Weight Dry	Overall Length	Overall Width	Overall Height	Gear Ratio
O-235-C1	4	108 h.p. at 2,600 r.p.m. (T.O. 115 h.p. at 2,800 r.p.m.)	233 cub. in. (3.85 litres)	6.75 : 1	80	237 lb. (107.5 kg.)	29.56 in. (751 mm.)	32.00 in. (812 mm.)	22.53 in. (570 mm.)	Direct
O-290-D2B	4	135 h.p. at 2,600 r.p.m. (T.O. 140 h.p. at 2,800 r.p.m.)	289 cub. in. (4.75 litres)	7.0 : 1	80/87	264 lb. (119.7 kg.)	29.56 in. (751 mm.)	32.24 in. (819 mm.)	22.81 in. (579 mm.)	Direct
O-320-A1A	4	150 h.p. at 2,700 r.p.m.	319.8 cub. in. (5.2 litres)	7.0 : 1	80/87	272 lb. (123.4 kg.)	29.56 in. (751 mm.)	32.24 in. (819 mm.)	23.12 in. (587.2 mm.)	Direct
O-320-B1A	4	160 h.p. at 2,700 r.p.m.	319.8 cub. in. (5.2 litres)	8.5 : 1	91/96	278 lb. (126 kg.)	29.56 in. (751 mm.)	32.24 in. (819 mm.)	23.12 in. (587.2 mm.)	Direct
O-340-A1A	4	170 h.p. at 2,700 r.p.m.	340.4 cub. in. (5.58 litres)	8.5 : 1	91/96	278 lb. (126.1 kg.)	29.56 in. (751 mm.)	32.55 in. (827 mm.)	24.68 in. (627 mm.)	Direct
O-340-B1A	4	160 h.p. at 2,700 r.p.m.	340.4 cub. in. (5.58 litres)	7.5 : 1	80/87	275 lb. (124.7 kg.)	29.56 in. (751 mm.)	32.55 in. (827 mm.)	24.68 in. (627 mm.)	Direct
O-360-A1A	4	180 h.p. at 2,700 r.p.m.	361 cub. in. (5.92 litres)	8.5 : 1	91/96	282 lb. (127.9 kg.)	29.56 in. (751 mm.)	33.57 in. (853 mm.)	24.68 in. (627 mm.)	Direct
O-360-B1A	4	168 h.p. at 2,700 r.p.m.	361 cub. in. (5.92 litres)	—	91/96	279 lb. (127 kg.)	29.56 in. (751 mm.)	33.57 in. (853 mm.)	24.68 in. (627 mm.)	Direct
O-435-A	6	190 h.p. at 2,550 r.p.m.	434 cub. in. (7.1 litres)	6.5 1	80	392 lb. (177.9 kg.)	38.10 in. (967 mm.)	32.24 in. (819 mm.)	29.59 in. (751 mm.)	Direct
GO-435-C2B2	6	240 h.p. at 3,000 r.p.m. (T.O. 260 h.p. at 3,400 r.p.m.)	434 cub. in. (7.1 litres)	7.3 : 1	80/87	430 lb. (195 kg.)	40.59 in. (1,031 mm.)	33.12 in. (842 mm.)	28.02 in. (712 mm.)	.642 : 1
VO-435-A1C	6	250 h.p. at 3,200 r.p.m. (T.O. 260 h.p. at 3,400 r.p.m.)	434 cub. in. (7.1 litres)	7.3 : 1	80/87	396 lb. (179.6 kg.)	35.17 in. (893 mm.)	25.19 in. (640 mm.)	33.32 in. (846 mm.)	Direct. For vertical mounting
VO-435-A1D	6	T.O. 260 h.p. at 3,400 r.p.m.	434 cub. in. (7.1 litres)	7.3 : 1	80/87	390 lb. (177 kg.)	35.17 in. (893 mm.)	25.19 in. (640 mm.)	33.32 in. (846 mm.)	Direct. For vertical mounting
GO-480-B1A6 and B1D	6	T.O. 270 h.p. at 3,400 r.p.m.	479.7 cub. in. (7.8 litres)	—	80/87	432 lb. (196 kg.)	—	33.12 in. (842 mm.)	28.02 in. (712 mm.)	.642 : 1
GO-480-G1B6	6	T.O. 295 h.p. at 3,400 r.p.m.	479.7 cub. in. (7.8 litres)	—	100/130	462 lb. (210 kg.)	—	33.12 in. (842 mm.)	26.34 in. (669 mm.)	.642 : 1
GO-480-G2D6	6	T.O. 295 h.p. at 3,400 r.p.m.	479.7 cub. in. (7.8 litres)	—	100/130	462 lb. (200.5 kg.)	—	33.12 in. (842 mm.)	28.02 in. (712 mm.)	.642 : 1
GO-480-D1A	6	260 h.p. at 3,000 r.p.m. (T.O. 275 h.p. at 3,400 r.p.m.)	479.7 cub. in. (7.8 litres)	7.3 : 1	80/87	453 lb. (205 kg.)	40.04 in. (1,017 mm.)	33.12 in. (842 mm.)	26.34 in. (669 mm.)	.642 : 1
GO-480-F1A6	6	265 h.p. at 3,100 r.p.m. (T.O. 275 h.p. at 3,400 r.p.m.)	479.7 cub. in. (7.8 litres)	7.3 : 1	80/87	436 lb. (198 kg.)	42.18 in. (1,072 mm.)	33.12 in. (842 mm.)	28.02 in. (712 mm.)	.642 : 1
GSO-480-B1A6	6	320 h.p. at 3,200 r.p.m. (T.O. 340 h.p. at 3,400 r.p.m.)	479.7 cub. in. (7.8 litres)	—	100/130	498 lb. (226 kg.)	46.22 in. (1,174 mm.)	33.12 in. (842 mm.)	29.40 in. (747 mm.)	.642 : 1
GSO-480-B1B6	6	320 h.p. at 3,200 r.p.m. (T.O. 340 h.p. at 3,400 r.p.m.)	479.7 cub. in. 7.8 litres)	—	100/130	500 lb. (227 kg.)	—	33.12 in. (842 mm.)	33.26 in. (845 mm.)	.642 : 1
GSO-480-B1C6	6	320 h.p. at 3,200 r.p.m. (T.O. 340 h.p. at 3,400 r.p.m.)	479.7 cub. in. (7.8 litres)	—	100/130	497 lb. (226 kg.)	—	33.12 in. (842 mm.)	22.56 in. (573 mm.)	.642 : 1
O-540-A1A	6	T.O. 250 h.p. at 2,575 r.p.m.	541.5 cub. in. (8.86 litres)	—	91/96	396 lb. (179.6 kg.)	—	33.37 in. (848 mm.)	25.81 in. (656 mm.)	Direct
SO-580-A1B	8	350 h.p. at 3,000 r.p.m. (T.O. 400 h.p. at 3,300 r.p.m.)	578 cub. in. (10.4 litres)	7.3 : 1	100/130	578 lb. (262.2 kg.)	46.62 in. (1,184 mm.)	33.12 in. (842 mm.)	24.49 in. (622 mm.)	Direct
GSO-580-D (O-580-1 military)	8	350 h.p. at 3,000 r.p.m. (T.O. 400 h.p. at 3,300 r.p.m.)	578 cub. in. (10.4 litres)	7.3 : 1	100/130	604 lb. (274 kg.)	56.86 in. (1,444 mm.)	33.18 in. (843 mm.)	34.22 in. (869 mm.)	.642 : 1
VSO-580-A1A (O-580-3 military)	8	350 h.p. at 3,000 r.p.m. (T.O. 400 h.p. at 3,300 r.p.m.)	578 cub. in. (10.4 litres)	7.3 : 1	100/130	591 lb. (268.1 kg.)	—	33.18 in. (843 mm.)	30.75 in. (781 mm.)	Direct. For vertical mounting





Above, the Lycoming GO-480-D1A and G1B6 engine.
On the right, the Lycoming GSO-480-B Series supercharged engine.

Stromberg PS-5BD single barrel carburettor attached to bottom of oil sump casting. The distributing zone is submerged in oil. Separate induction pipes lead to inlet valves.

IGNITION.—Two Bendix-Scintilla magnetos driven by spur gears from the timing gear.

LUBRICATION.—Full pressure type, including valve mechanism. Crankshaft equipped with centrifugal sludge-removers. Pistons, gudgeon-pins and accessory drive gears lubricated by splash.

ACCESSORY HOUSING.—Aluminium-alloy casting bolted to rear of crankcase and top rear of oil sump. Houses oil pump and geared accessory drives, and provides mounting for starter and generator, fuel pump, tachometer drive and magnetos. Vacuum pump drive optional equipment.

STARTING.—Delco-Remy 12-volt automotive type starter. Starter torque applied to crankshaft gear through Bendix-type starter drive.

DIMENSIONS, WEIGHTS AND PERFORMANCE.—See Table.

THE LYCOMING O-480 SERIES.

The O-480 Series is basically the same as the O-435 Series except for an increase in cylinder bore to $5\frac{1}{8}$ in. (130 mm.) and in swept volume to 479.7 cub. in. (7.85 litres). The geared and normally aspirated engines are available in low and high-compression versions for use with 80/87 or 100/130 minimum octane fuels respectively. The geared and supercharged GSO-480-B Series have a supercharger drive ratio of 11.27 : 1, providing rated power to 8,000 ft. (2,440 m.) on 100/130 minimum octane fuel. High-compression and supercharged engines are provided with internal oil cooling of the pistons as standard equipment. For other details see Table.

THE LYCOMING O-540 SERIES.

The O-540 is basically a direct-drive six-cylinder version of the four-cylinder O-360 with the same bore and stroke and a swept volume of 541.5 cub. in. (8.86 litres). It is currently available in a high-compression configuration for use with 91/96 minimum octane fuel. A low-compression model for use with 80/87 fuel can be provided. For other details see Table.

THE LYCOMING GSO-580 SERIES.

Current GSO-580 Series engines are the GSO-580-C and GSO-580-D (Military designation O-580-1). Details of both these engines will be found in the Table. The GSO-580-C is identical to the GSO-580-D except that it is rated on 91/96 Grade fuel at 375 h.p. at 3,300 r.p.m. for take-off and 320 h.p. at 3,000 r.p.m. maximum continuous.

Model SO-580-A1A is the same as the GSO-580-D less the reduction gear, for horizontal helicopter installation. The VSO-580-A1A is the same but suitable for vertical installation.

TYPE.—Eight-cylinder horizontally-opposed air-cooled, geared and supercharged.

CYLINDERS.—Bore $4\frac{7}{8}$ in. (123.7 mm.). Stroke $3\frac{7}{8}$ in. (98.4 mm.). Displacement 578 cub. in. (10.4 litres). Compression ratio 7.30 :1. Aluminium-alloy heads, with 50% increase in fin area over previous Lycoming head design, screwed and shrunk onto steel barrels. Cylinder assemblies attached to crankcase by studs and nuts.

PISTONS.—Forged aluminium pistons with three rings above gudgeon-pin and one below. Top ring is a compression ring, wedge type, chrome plated. Second ring, also compression type, is cast iron wedge type. Third ring is an oil regulating ring. Fourth ring is an oil scraper below fully-floating gudgeon-pin.

CONNECTING RODS.—H-section alloy steel. Fitted with replaceable inserts at crank-pin journals and bronze bushings at piston-pin ends.

CRANKCASE.—Two machined aluminium-alloy castings joined on vertical centre-line by through bolts and studs.

CRANKSHAFT.—Eight-throw chrome nickel molybdenum shaft on five main bearings. Fitted with four pairs of dynamic dampers tuned to crankshaft torsional period to eliminate fourth order torsional vibration.

REDUCTION GEAR.—Planetary type, 77 : 120 ratio.

AIRSCREW GOVERNOR DRIVE.—AND-20010 airscrew governor drive on reduction-gear housing, permitting use of a hydraulically-controlled constant-speed airscrew.

CARBURATION.—Pressure-type Bendix carburettor Model PS-9BDE with altitude control and solenoid primer.

SUPERCHARGER.—Centrifugal type supercharger with a single outlet directly connected to central distributing zone with four Y-type intake pipes connecting distributing zone to cylinders. Ratio 7.9 : 1.

IGNITION.—Two Scintilla S4RN-21 magnetos.

LUBRICATION.—Full-pressure dry sump.

ACCESSORIES.—Pads for mounting starter, generator, fuel pump, hydraulic pump, vacuum pump and tachometer. All accessories are side-mounted for ease of servicing.

DIMENSIONS. WEIGHTS AND PERFORMANCE.—See Table.

McCULLOCH

McCULLOCH MOTORS CORPORATION.

HEAD OFFICE AND MAIN PLANT : 6101, WEST CENTURY BLVD., LOS ANGELES 45, CALIFORNIA.

President : Robert P. McCulloch.
Chairman : Joseph L. Hegener.
Executive Vice-President : Sherwood H. Egbert.

Vice-Presidents in charge of Advance Development : John L. Ride, Gerald K. Robechaud and James L. Dooley.

Vice-President, Manufacturing : George Eichelsbach.

Vice-President, Sales : C. F. Breer.

Secretary and Assistant Treasurer : J. D. Cavanaugh.

Chief Engineer : H. J. Buttner.

McCulloch Motors Corpn. produces a variety of gasoline-engine products, making extensive use of high-pressure die casting of aluminium and magnesium.

Since 1943 the company has been producing engines for use in radio-controlled target aircraft and helicopters. The latest of these are described below.

THE McCULLOCH MODEL 4318A.
Military designation: O-100-1.

TYPE. — Four-cylinder horizontally-opposed air-cooled two-stroke.

CYLINDERS.—Bore $3\frac{3}{16}$ in. (80.8 mm.). Stroke $3\frac{1}{8}$ in. (79.4 mm.). Displacement 100 cub. in. (1.6 litres). Compression ratio 7.8 : 1. Heat-treated die-cast aluminium cylinders with integral heads, having hard chrome plated cylinder walls. Self-locking nuts secure cylinders to crankcase studs.

PISTONS.—Heat-treated cast aluminium. Two rings above pins. Piston pins of case-hardened steel.

CONNECTING RODS.—Forged steel. Split big-end carries bearing rollers in heat-treated beryllium copper cages. Small-end carries two needle bearings.

CRANKSHAFT.—Four-throw one-piece steel forging on four anti-friction bearings, two ball and two needle, one with split race for centre main bearing.

CRANKCASE.—One-piece heat-treated permanent-mould aluminium casting closed at rear end with cast aluminium cover which provides mounting for magneto.

VALVE GEAR.—Fuel mixture for scavenging and power stroke introduced to cylinders through crankshaft-driven rotary valves and ported cylinders.

INDUCTION.—Crankcase pumping type. McCulloch diaphragm-type carburettor with adjustable jet.

FUEL SPECIFICATION.—Mil-F-5572 Grade 115/145 aviation fuel.

IGNITION.—McCulloch single magneto and distributor. Directly connected to crankshaft through impulse coupling for easy starting. Radio noise suppressor included. BG type RB-936S spark plugs. Complete radio shielding.

LUBRICATION.—Oil mixed with fuel as in conventional two-stroke engines.

AIRSCREW DRIVE.—Direct. R.H. tractor. Keyed taper shaft.

STARTING.—By separate portable gasoline or electric motor with suitable reduction-gear and clutch. Can be started manually by hand-cranking airscrew.

MOUNTING.—Three mounting lugs provided with sockets for rubber mounting bushings.

DIMENSIONS.—
Overall length 27.0 in. (68.6 cm.).
Overall width 28.0 in. (71.1 cm.).
Overall height 15.0 in. (38.1 cm.).

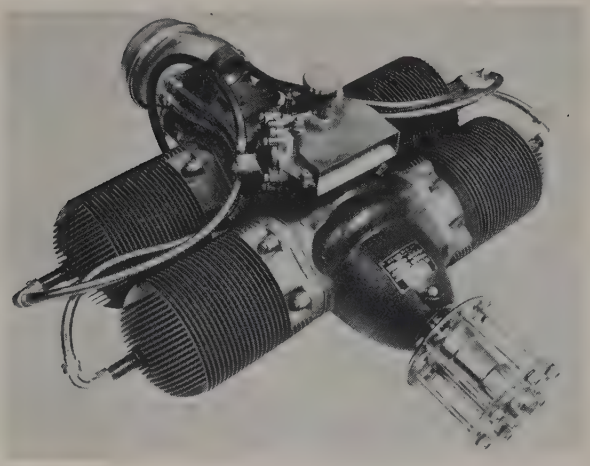
WEIGHT (complete, but less airscrew hub).—77 lb. (34.9 kg.).

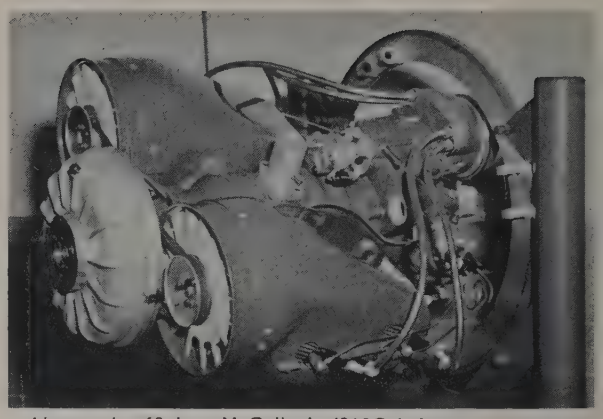
POWER RATING.—
Rated output 72 h.p. at 4,100 r.p.m.

CONSUMPTION.—
Fuel/oil mixture 0.90 lb./b.h.p./hr. (0.408 kg./b.h.p./hr.).

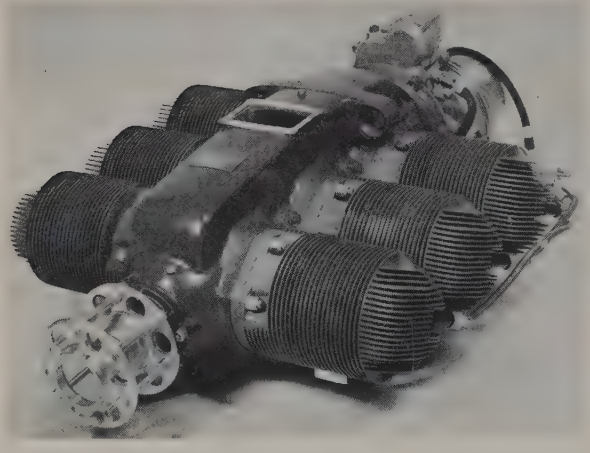
THE McCULLOCH MODEL 4318B.
Military designation: O-100-2.

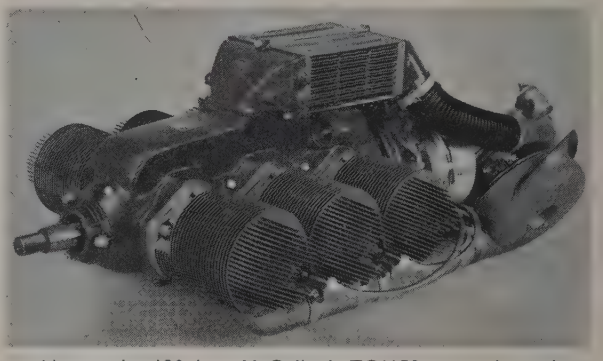
The Model 4318B differs from the 4318A in that it employs the same cylinders, pistons and connecting-rods as the Model 6318 six-cylinder engine described later. The later design cylinder features a relocated sparking plug position which makes possible a reduction in the overall width of the engine by 6 in. (15.2 cm.). The newer pistons have three rings instead of two and the lateral





Above, the 60 h.p. McCulloch 4318C helicopter engine.
Left, the 72 h.p. McCulloch 4318A four-cylinder engine.





Above, the 120 h.p. McCulloch TC6150 supercharged engine.

Left, the 110 h.p. McCulloch 6318 six-cylinder engine.

position of the connecting-rod is controlled by thrust washers between the piston pin bosses and the corresponding end of the rod. The 4318B carburettor has a fixed jet and it incorporates a simple two-position altitude compensator for improved altitude performance.

In all other respects the two engines are the same.

DIMENSIONS.—
Same as for Model 4318A except :—
Width 22.0 in. (55.8 cm.).

WEIGHT AND PERFORMANCE.—
Same as for Model 4318A.

THE McCULLOCH MODEL 4318C.

Military designation: YO-100-4.

Intended for helicopter applications, the Model 4318C is basically similar to the Model 4318B, but features optional direct fuel injection or carburettor fuel system, can be mounted vertically and can be equipped with a fluid coupling to eliminate a manually-operated clutch and to reduce torsional vibration passed on to helicopter rotor blades.

TYPE.—Four-cylinder horizontally-opposed air-cooled two-stroke.

CYLINDERS, PISTONS, CONNECTING RODS, CRANKSHAFT, CRANKCASE, VALVE GEAR (with carburettor), IGNITION and LUBRICATION.—Same as Model 4318B, except compression ratio 7.0 : 1. B.G. type RB-916S spark plugs.

INDUCTION.—Crankcase scavenging type. Tillotson Model OM carburettor or optional direct fuel injection.

FUEL.—Mil-F-5572 Grade 115/145 aviation fuel mixed in a ratio of 10 to 1 with oil to Mil-O-6082 Grade 1065.

EQUIPMENT (Optional).—Fluid coupling on drive end of crankshaft.

STARTING.—Automatic rewind pull-type manual starter.

MOUNTING.—Four mounting lugs provided with sockets for rubber mounting bushes.

DIMENSIONS.—
Overall length 28.0 in. (71.1 cm.).
Overall width 24.8 in. (63.0 cm.).
Overall height 15.5 in. (39.4 cm.).

WEIGHT (dry, without fluid coupling).—
105 lb. (47.63 kg.).

POWER RATING.—
Rated output 60 h.p.

CONSUMPTIONS.—
Fuel/oil mixture 0.82 lb./b.h.p./hr. (0.37 kg./b.h.p./hr.).

THE McCULLOCH MODEL 4318E.

The Model 4318E is identical with the Model 4318B in every respect, except that it is intended to drive a pusher airscrew, for use in the Bensen Model B-8M Gyro-Copter light helicopter. No carburettor is supplied with the engine ; but a Carter Model YF 938SA, with main metering rod jet enlarged to No. 42 drill size, has been used successfully.

DIMENSIONS, WEIGHT AND PERFORMANCE.—
Same as for Model 4318B.

THE McCULLOCH MODEL 6318.

Military designation: O-150-2.

The Model 6318 differs from the 4318B in that it has six cylinders, a torsional vibration damper, a medium-pressure continuous fuel-injection system instead of a carburettor and a continuously-variable altitude compensator.

TYPE.—Six-cylinder horizontally-opposed air-cooled two-stroke.

CYLINDERS, PISTONS, CONNECTING RODS AND VALVE GEAR.—
Same as for Model 4318B. Displacement 150 cub. in. (2.4 litres).

CRANKSHAFT.—Six-throw one piece steel forging. One ball and four needle bearings, two with split race for centre main bearings.

CRANKCASE.—One-piece heat-treated permanent-mould aluminium casting.

INDUCTION.—Crankcase scavenging with rotary valves. Continuous injection into crankcase through fixed jets. Fuel supplied and metered by McCulloch two-stage rotary-pump with altitude compensator.

FUEL SPECIFICATION.—MIL-F-5572 Grade 115/145 aviation fuel mixed in ratio of 10 to 1 with oil to Mil-O-6082 Grade 1065.

IGNITION, LUBRICATION, AIRSCREW DRIVE, STARTING AND MOUNTING.—Same as for Model 4318B.

ACCESSORIES.—Alternator pad and auxiliary drive pad on rear cover casting. Both gear-driven.

DIMENSIONS.—
Overall length 34.5 in. (87.6 cm.).
Overall width 22.0 in. (55.8 cm.).
Overall height 12.3 in. (31.2 cm.).

WEIGHT (complete, less airscrew hub).—
114 lb. (51.7 kg.).

POWER RATING.—
Rated output 110 h.p. at 4,100 r.p.m.

CONSUMPTION.—
Fuel/oil mixture 0.85 lb./h.p./hr. (0.38 kg./b.h.p./hr.).

THE McCULLOCH MODEL TC6150.

Military designation: O-150-4.

The Model TC6150 is a turbo supercharged version of the 6318, to which it is otherwise similar.

TYPE.—Six-cylinder horizontally-opposed air-cooled supercharged two-stroke.

CYLINDERS, PISTONS, CONNECTING RODS, VALVE GEAR, IGNITION, LUBRICATION, AIRSCREW DRIVE, STARTING AND MOUNTING.—Same as Model 4318B.

CRANKSHAFT, CRANKCASE, INDUCTION, FUEL SPECIFICATION AND ACCESSORIES.—Same as for Model 6318.

SUPERCHARGER.—Exhaust-driven open-end design with radial inflow single-stage turbine and single-stage centrifugal compressor.

DIMENSIONS.—
Overall length 44.5 in. (113 cm.).
Overall width 22.0 in. (55.8 cm.).
Overall height 17.0 in. (43.2 cm.).

WEIGHT (Dry).—
142 lb. (64.4 kg.).

POWER RATINGS.—
Rated output at sea level 120 h.p.
Rated output at 30,000 ft. (9,150 m.) 86 h.p.

CONSUMPTION.—
Fuel/oil mixture 0.80 lb./b.h.p./hr. (0.36 kg./b.h.p./hr.).

NELSON

BARMOTIVE PRODUCTS, INC.

HEAD OFFICE AND WORKS: 440, PERALTA AVENUE, SAN LEANDRO, CALIFORNIA.

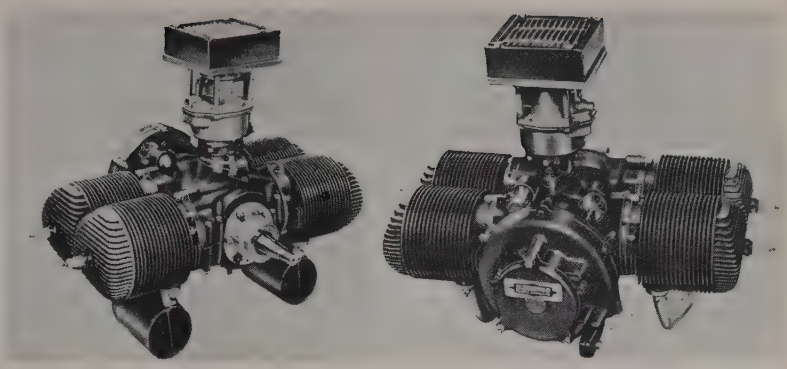
President: W. W. Barton.

Vice-President and General Manager: C. H. Whitner.

Secretary and Treasurer: J. M. Hardin.

Special Consultant: Ted Nelson.

Barmotive Products, Inc., among their many industrial activities, produce the Nelson H-63 four-cylinder two-cycle air-cooled engine. Intended as a power unit for single-seat experimental helicopters and aircraft employing the "ducted fan" principle, it is a development of an earlier Nelson engine, which was tested and approved by the Civil Aeronautics Authority as a power source for auxiliary-powered sailplanes and has been described fully in previous editions of "All the World's Aircraft."



Two views of the 42 h.p. Nelson H-63 four-cylinder two-stroke engine.

THE NELSON H-63.

The H-63 engine was designed to provide a small power-unit having a high ratio of horse-power to basic weight (42 h.p./48 lb.). Liberal use of magnesium and aluminium-alloys is made to keep the weight down to the minimum.

The thrust bearing is suitable for a pusher or tractor type airscrew. Installation can be made with the crankshaft in either the horizontal or vertical position, each position requiring its own specially modified carburettor.

TYPE.—Four-cylinder horizontally-opposed air-cooled, two-stroke.

CYLINDERS.—Bore 2 1/16 in. (68.3 mm.). Stroke 2 3/4 in. (70 mm.). Displacement 63 cub. in. (1.03 litres). Compression ratio 8 : 1. Each cylinder complete is machined from an aluminium-alloy casting, the bore being porous-chrome plated for wear resistance. Cylinders bolted to and detachable from crankcase.

PISTONS.—Aluminium-alloy casting. Two piston rings. Standard automotive type gudgeon pins.

CONNECTING RODS.—Nitralloy with needle bearing in big end and caged roller bearing in little end.

CRANKSHAFT.—Four-throw Nitralloy shaft on four ball bearings.

CRANKCASE.—Two-piece case divided on horizontal centre-line. Each half is a magnesium casting.

INDUCTION.—Standard Fish M-2 automobile carburettor specially modified for this engine. Fuel/oil mixture valved from crankcase through specially-designed rotary valve driven by crankshaft. Intake to and exhaust from cylinders through ports. Exhaust stacks are of aluminium-alloy.

FUEL.—80 octane gasoline and SAE 30 paraffin-base oil in 8 : 1 mixture for fuel and lubrication.

IGNITION.—Electrical source is 6- or 12-volt battery. Two ignition coils with standard wiring. One Champion No. 5 commercial plug per cylinder.

LUBRICATION.—See under "Fuel."

AIRSCREW DRIVE.—Direct, counter-clockwise. Type of airscrew varies with application. Recommended diameter for use with ultra-light aircraft or power-assisted sailplanes is 42 inches (1.06 m.).

STARTING.—Steel cable from cockpit to starter mechanism. Electric starter optional.

MOUNTING.—Four Lord-type mounts, two on each half of crankcase.

DIMENSIONS.—
Overall length 18 in. (45.7 cm.).
Overall height 17.5 in. (44.4 cm.).
Overall width 25 in. (63.5 cm.).

WEIGHTS.—
Dry, less carburettor and exhaust stacks 48 lb. (21.8 kg.).
Carburettor (with filter) 2 lb. (0.9 kg.).
Exhaust stacks (2) 2.5 lb. (1.1 kg.).
Coils (2) 2.5 lb. (1.1 kg.).

POWER RATING.
Rated output 42 h.p. (min.) at 4,000 r.p.m.

CONSUMPTION.—
Fuel/oil 5.5 U.S. gallons (20.8 litres) per hour at full throttle.

PRATT & WHITNEY

THE PRATT & WHITNEY AIRCRAFT DIVISION OF UNITED AIRCRAFT CORPORATION.

HEAD OFFICE AND WORKS: EAST HARTFORD 8, CONNECTICUT.

Established: 1925.

Vice-President: Wright A. Parkins.

General Manager (Connecticut): L. C. Mallet.

Engineering Manager: Perry W. Pratt.

Assistant Engineering Manager: B. A. Schmickrath.

Sales Manager: B. J. McNamara.

Factory Manager: John L. Bunce.

Pratt & Whitney concentrates on the manufacture of high-powered gas-turbines and radial air-cooled engines. It was founded in 1925 by a small group of aeronautical engine experts as the Pratt & Whitney Aircraft Company and is now a division of the United Aircraft Corporation.

Production space in the main East Hartford, Connecticut, plant and in the branch plants at North Haven, Southington and Meriden, Connecticut, totals more than 7,000,000 square feet. Employment in all Pratt & Whitney plants was about 38,000 on January 1, 1958.

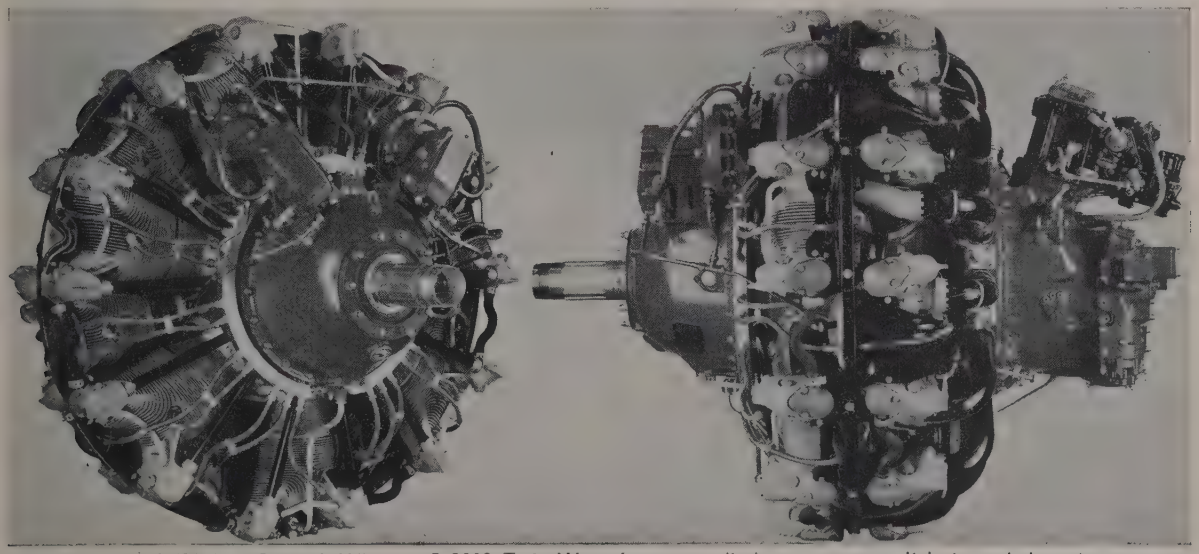
Current production piston-engines are the R-2000 and R-2800; but large numbers of earlier engines remain in service, notably the 450 h.p. R-985, 600 h.p. R-1340, 1,200 h.p. R-1830 and 3,500 h.p. R-4360. All of these have been described in previous editions of "All the World's Aircraft."

In 1958 over 80% of Pratt & Whitney production capacity was devoted to gas-turbine engines. Details of these engines will be found in Part I of this Section.

THE PRATT & WHITNEY R-2000 TWIN-WASP D SERIES.

TYPE.—Fourteen-cylinder two-row air-cooled radial.

CYLINDERS.—Bore 5 3/4 in. (146 mm.). Stroke 5 1/2 in. (139.50 mm.). Displacement 2,004 cub. in. (32.8 litres). Built up of cast aluminium head, with integral valve mechanism housing, screwed and shrunk on a forged steel cylinder barrel. Forged aluminium sleeve in which deep-cut cooling fins have been machined (muffs) are shrunk over the central portion. Each cylinder has one inlet and one exhaust valve, seating on inserts which are shrunk into head. Pressure baffles are provided.



The 1,450 h.p. Pratt & Whitney R-2000 Twin-Wasp fourteen-cylinder two-row radial air-cooled engine.

THE PRATT & WHITNEY TWIN WASP R-2000 D SERIES.

Engine Model	Take-off Power	Normal Rating (low blower)	Normal Rating (high blower)	Max. Continuous Power	Compression Ratio	Blower Ratio	Gear Ratio	Weight Dry	Diameter	Fuel Grade
D5	1,450 h.p. at 2,700 r.p.m. at 2,800 ft. (855 m.)	1,200 h.p. at 2,550 r.p.m. at 6,400 ft. (1,952 m.)	—	—	6.5 : 1	7.15 : 1	.500 : 1	1,585 lb. (719 kg.)	49.10 in. (1.247 m.)	100/130
2SD13-G	1,450 h.p. at 2,700 r.p.m. at 1,000 ft. (305 m.)	1,200 h.p. at 2,550 r.p.m. at 5,000 ft. (1,525 m.)	1,100 h.p. at 2,550 r.p.m. at 14,000 ft. (4,265 m.)	—	6.5 : 1	7.15 : 1 (L) and 9.52 : 1 (H)	.500 : 1	1,605 lb. (728 kg.)	49.10 in. (1.247 m.)	100/130

PISTONS.—Of forged aluminium, ribbed on underside of head for additional cooling. Each piston has three compression-rings, one oil scraper-ring and one pair of dual oil control rings.

CONNECTING RODS.—The master rod cluster consists of the master rod, with detachable cap and two piece lead-silver bearing, and six I-section articulated rods for each row. Each articulated rod has bronze bushings at both piston and knuckle pin ends.

CRANKSHAFT.—Forged steel, two-throw counter-weighted, one-piece type, supported by three plain lead-silver bearings in the crankcase section.

CRANKCASE.—Made up of seven sections. The three parts for the power section, or crankcase proper, are machined together from aluminium forgings. The magnesium nose section houses the reduction gears and has provision for the Hamilton Standard Hydromatic or other full-feathering airscrews. The power sections are joined by through bolts. The magnesium blower section, bolted to the power section, contains the supercharger and carries bronze-bushed forged-steel engine mounting lugs. The blower intermediate section, bolted to the blower section, supports the downdraft carburettor and houses the impeller gear train. The accessory section, also of magnesium, is fastened to the blower intermediate section by means of stud bolts.

VALVE GEAR.—One inlet and one exhaust valve per cylinder. Exhaust valves are sodium-cooled and faced with stellite. Valves are actuated by plain bearing rocker arms and push-rods. Two shelf-mounted cams, one in front power section and one in rear, driven by spur reduction gears directly off the crankshaft at one-eighth crankshaft speed.

INDUCTION SYSTEM.—Stromberg PD-12F13 pressure-injection carburettor with automatic mixture control, idle cut-off, primer tubing and distributor. Metered fuel is carried through internal passage and is thrown centrifugally through small holes in a slinger ring mounted on the impeller drive shaft. Combustion air enters the supercharger at right angles to the screen of vaporized fuel thrown from the slinger ring. Fuel air mixture after being compressed collects in the blower rim from where it is carried through intake pipes to the individual cylinders. The "washboard" impeller case provides better fuel vaporization, preventing the accumulation and flow of liquid fuel along the wall by returning it to the air stream.

SUPERCHARGER.—Either single-speed or two-speed, and is single-stage. Impeller is driven by spring-loaded flexible drive gears to absorb shocks and to equalize driving loads, plus cone clutches with creeper desludgers in the case of two-speed drive engines.

IGNITION SYSTEM.—Two nose-mounted Scintilla SF-14LN-8 magnetos each operate an individual set of spark-plugs through a single ignition manifold attached to the front of the power section. Magnetos, manifold and spark-plug leads are radio-shielded.

LUBRICATION.—Forced feed lubrication by a gear-type oil pump to all parts of the engine.

REDUCTION GEAR.—The planetary reduction gears of Pratt & Whitney design. Ratio .500 : 1. Airscrew shaft supported at the crankshaft end in two concentric bearings mounted in a support plate at the rear of the nose housing and at the front of the nose section by a deep-groove ball-bearing. The airscrew shaft is completely decoupled from the crankshaft.

ACCESSORY DRIVES.—All accessories are grouped in the rear and are driven through intermediate gear train by a single drive-shaft spline fitted to the rear of the crankshaft.

DIMENSIONS, WEIGHTS AND PERFORMANCE.—See Table.

THE PRATT & WHITNEY R-2800 DOUBLE WASP CB SERIES.

TYPE.—Eighteen-cylinder two-row air-cooled radial.

CYLINDERS.—Bore 5¾ in. (146 mm.). Stroke 6 in. (152.4 mm.). Capacity 2,804 cub. in. (45.9 litres). Built up of forged aluminium head, with integral valve mechanism housing, screwed and shrunk on a forged steel cylinder barrel. Forged aluminium sleeves in which deep-cut cooling fins have been machined, are shrunk over the central portion. Each cylinder has one inlet and one exhaust valve, the inlet seating on a bronze insert and the exhaust on a steel insert, both of which are shrunk into the head. Pressure baffles are provided.

PISTONS.—Forged aluminium pistons of full skirt type. Three compression rings, one pair of dual oil control rings and one oil scraper ring. Top compression ring chromium plated on the face which bears against the cylinder wall.

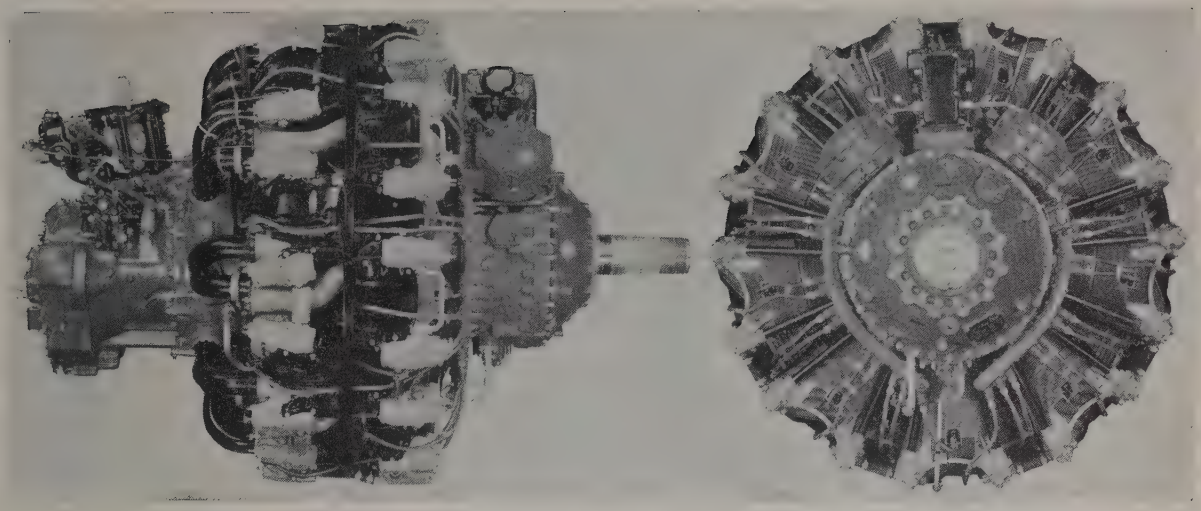
CONNECTING RODS.—The rod assembly consists of a one-piece master rod and eight I-section articulated rods attached to each master rod by knuckle pins. The master rod bearings are one-piece steel shells covered on the inside and outside with leaded silver. The articulated rods have bronze bushings at the piston pin end and ride on silvered knuckle pins at the knuckle pin end.

CRANKSHAFT.—Two-throw crankshaft machined from three steel forgings which divide at the crankpins and are joined together by a face spline and bolt. Crankshaft assembly supported by steel-backed lead-silver bearings mounted in the front, centre and rear main crankcase sections. Weights of reciprocating and rotating parts connected to the crankpin are counterbalanced by weights, the front counter balance and a portion of the improved rear one being mounted as bifilar dampers. Mounted at

THE PRATT & WHITNEY R-2800 DOUBLE WASP CB SERIES.

Engine Model	Take-off Power	Normal Rating (low blower)	Normal Rating (high blower)	Max. Continuous Power (low blower)	Max. Continuous Power (high blower)	Blower Ratio	Gear Ratio	Weight Dry	Diameter	Fuel Grade
*CB3	‡2,400 h.p. at 2,800 r.p.m. at 4,000 ft. (1,220 m.) 2,050 h.p. at 2,700 r.p.m. at 6,000 ft. (1,830 m.)	1,800 h.p. at 2,600 r.p.m. at 8,500 ft. (2,590 m.)	—	1,800 h.p. at 2,600 r.p.m. at 8,500 ft. (2,590 m.)	—	7.29 : 1	.45 : 1	2,357 lb. (1,070 kg.)	52.8 in. (1,342mm.)	100/130
*CB4	‡2,500 h.p. at 2,800 r.p.m. at 2,500 ft. (760 m.) 2,200 h.p. at 2,800 r.p.m. at 4,500 ft. (1,370 m.)	1,800 h.p. at 2,600 r.p.m. at 8,500 ft. (2,590 m.)	—	1,900 h.p. at 2,600 r.p.m. at 7,000 ft. (2,135 m.)	—	7.29 : 1	.45 : 1	2,357 lb. (1,070 kg.)	52.8 in. (1,342 mm.)	108/135
†CB16	‡2.400 h.p. at 2,800 r.p.m. at 4,000 ft. (1,220 m.) 2,050 h.p. at 2,700 r.p.m. at 6,000 ft. (1,830 m.)	1,800 h.p. at 2,600 r.p.m. at 8,500 ft. (2,590 m.)	1,600 h.p. at 2,600 r.p.m. at 16,000 ft. (4,880 m.)	1,800 h.p. at 2,600 r.p.m. at 8,500 ft. (2,590 m.)	1,700 h.p. at 2,600 r.p.m. at 14,500 ft. (4,420 m.)	7.29 : 1 (L) 8.58 : 1 (H)	.45 : 1	2,390 lb. (1,084 kg.)	52.8 in. (1,342 mm.)	100/130
†CB17	‡2,500 h.p. at 2,800 r.p.m. at 2,500 ft. (760 m.) 2,200 h.p. at 2,800 r.p.m. at 4,500 ft. (1,370 m.)	1,800 h.p. at 2,600 r.p.m. at 8,500 ft. (2,590 m.)	1,700 h.p. at 2,600 r.p.m. at 14,500 ft. (4,420 m.)	1,900 h.p. at 2,600 r.p.m. at 7,000 ft. (2,135 m.)	1,750 h.p. at 2,600 r.p.m. at 13,500 ft. (4,115 m.)	7.29 : 1 (L) 8.58 : 1 (H)	.45 : 1	2,390 lb. (1,084 kg.)	52.8 in. (1,342 mm.)	108/135

* Single-speed single-stage supercharger. † Two-speed single-stage supercharger. ‡ With water injection.



The 2,400 h.p. Pratt & Whitney R-2800 Double Wasp CA and CB Series eighteen-cylinder radial engine.

each end of the crankshafts are two counterweights revolving at twice-crankshaft speed to eliminate second-order "whirl."

Crankcase.—Main crankcase composed of three forged aluminium-alloy sections held together by through bolts. Nose-section houses the reduction gears and torquemeter and has provisions for full-feathering, reversible governor. Supercharger case attached to the rear of the main crankcase section and also houses an impeller. Intermediate rear case is attached to supercharger case and supports at its forward face a vaned diffuser plate and provides mounting surface for a pressure type carburettor. Rear section provides accessory mounting pads.

Remarks.—The valve gear, induction-system, supercharger, ignition system, lubrication system and accessory-drives are substantially the same as in the Twin-Wasp, but with Stromberg PR-58E5 carburettor and Scintilla DLN-10 magnetos. The ignition system is optionally high or low voltage. Water-injection equipment may be used with the "CA" Double-Wasp to give added power for take-off and emergencies.

Dimensions, Weights and Performance.—See Table.

WRIGHT

WRIGHT AERONAUTICAL DIVISION, CURTISS-WRIGHT CORPORATION.

Head Office and Works: Wood-Ridge, N.J.

Chairman of the Board and President: Roy T. Hurley.

Vice-President and General Manager: J. V. Miccio.

Director of Engineering: Joseph P. Grandfield.

The Wright Aeronautical Corporation merged with the Curtiss Aeroplane and Motor Company in 1929 to form the Curtiss-Wright Corporation.

Wright piston engines range in power from 800 to 2,800 horsepower, while the Wright Turbo Compound, a combination piston and turbine engine which develops up to 3,700 h.p. is the only compound engine powering production aircraft.

All Lockheed Constellation airliners are powered by four Wright R-3350 eighteen-cylinder engines. The Wright Turbo Compound engine powers the Lockheed P2V and WV and Martin P5M patrol aircraft and the Lockheed R7V-1 transport in service in the U.S. Navy, as well as the Fairchild C-119 and Lockheed C-121 transports of the U.S.A.F. and the Canadair CL-28 maritime reconnaissance aircraft of the R.C.A.F. The Turbo Compound also powers the later versions of the Super Constellation, the Lockheed Starliner and the Douglas DC-7 airliner.

Production of the R-1300 Cyclone 7 Series and R-1820 Cyclone 9 Series engines, both military and civil, continues, mainly for helicopter applications. Details of these engines have appeared in earlier editions of "All the World's Aircraft."

In 1956, Wright took long-term leases on factories belonging to the Studebaker-Packard Corporation, at Utica, Mich., and Chippewa, Ind., and purchased the Aerophysics Development Corporation of Santa Barbara, Cal. All three plants are operating as wholly-owned subsidiaries of Curtiss-Wright. Present production in them is concentrated on production of engine components and diesel engines for aviation, automotive, marine and industrial application.

THE WRIGHT R-3350 CYCLONE 18 SERIES.

Type.—Eighteen-cylinder double-row geared and supercharged radial air-cooled.

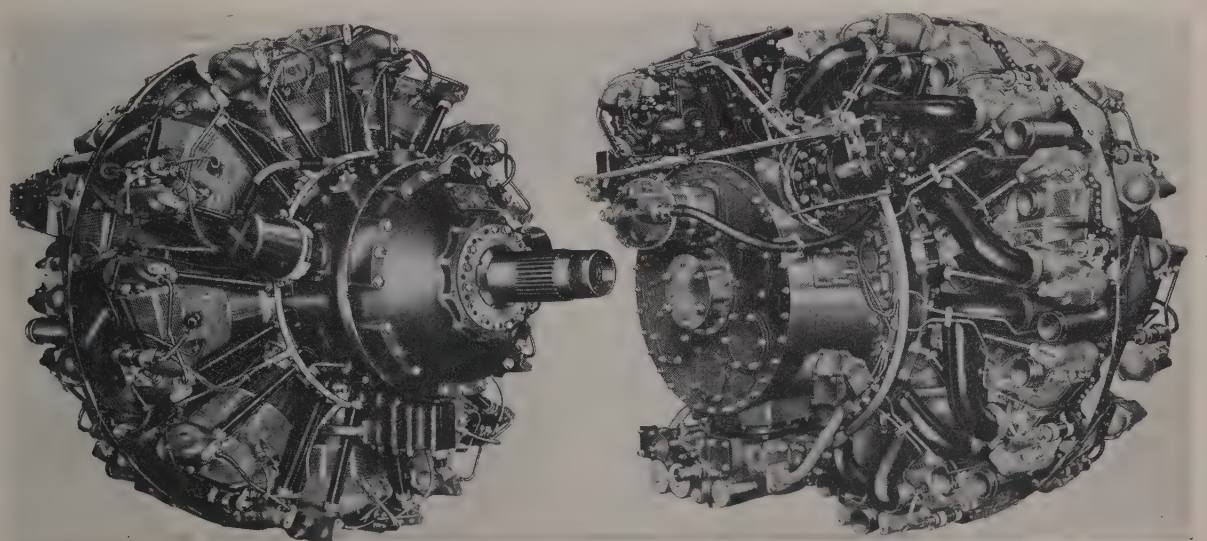
Cylinders.—Bore 6.125 in. (155.6 mm.). Stroke 6.312 in. (160.2 mm.). Capacity 3,347 cub. in. (54.56 litres). Universal-type forged head with "coarse/fine" finning and increased finning in area of exhaust-valve for improved cooling. Forged head has greater total cooling area than cast type used on earlier C18's. Rocker boxes are slightly smaller than type previously used and are held in place by five studs.

Pistons.—Tapered interior to accommodate tapered articulated and master-rod ends. Five piston rings, three oil and two compression.

Connecting Rods.—Gudgeon-pin end of articulated rods tapered to accommodate maximum thrust on down stroke and lesser thrust on return stroke. Gudgeon-pin and knuckle pin bearings of bronze. Silver master-rod bearing is steel-backed and end-sealed. All rods shot-peened during manufacture.

Crankshaft.—Two-throw forged steel crankshaft dynamically-balanced with single-weight second-order balancers concentric with crankshaft.

Crankcase.—Eight-piece crankcase. Power section of forged steel front and rear sections of magnesium-alloy. Front or nose section in two pieces to facilitate maintenance. Reduction gears are "high overlap" type for increased tooth contact. Ball thrust-



The 2,500 h.p. Wright R-3350 Cyclone 18BD eighteen-cylinder two-row radial air-cooled engine.

THE WRIGHT R-3350 CYCLONE 18 SERIES.

Engine Model	Take-off Horsepower	Normal Rating (low blower)	Normal Rating (high blower)	Compression Ratio	Blower Ratio	Reduction Gear Ratio	Dry Weight	Fuel Grade
745C18BA1 (Fuel Injection)	2,200 h.p. at 2,800 r.p.m.	2,000 h.p. at 2,400 r.p.m. at 4,800 ft. (1,465 m.)	1,800 h.p. at 2,400 r.p.m. at 15,000 ft. (4,575 m.)	6.5 : 1	6.46 : 1 and 8.67 : 1	.4375 : 1	2,780 lb. (1,261 kg.)	100/130
749C18BD1 (Fuel Injection)	2,500 h.p. at 2,800 r.p.m.	2,100 h.p. at 2,400 r.p.m. at 4,400 ft. (1,340 m).	1,470 h.p. at 2,400 r.p.m. at 11,000 ft. (3,350 m.)	6.5 : 1	6.46 : 1 and 8.67 : 1	.4375 : 1	2,915 lb. (1,323 kg.)	100/130
975C18CB1 (Fuel Injection)	2,800 h.p. at 2,900 r.p.m.	2,400 h.p. at 2,600 r.p.m. at 5,300 ft. (1,615 m.)	2,000 h.p. at 2,600 r.p.m. at 16,000 ft. (4,880 m.)	6.7 : 1	6.46 : 1 and 8.67 : 1	.4375 : 1	3,065 lb. (1,391 kg.)	115/145

bearing mounted in front section and roller-main bearings mounted in webs of crankcase power section. Electric torque pressure indicator and provision for double-acting hydraulic airscrew provided in front section.

VALVE GEAR.—Valve seats Stellite-faced and shrunk into aluminium-alloy head. Rocker-arm ratio 1 : 1. Rocker-arms pivot on plain bearings. Push-rods enclosed in tubular housings with gland-type seals.

FUEL METERING.—BA, BD and CA models manufactured with direct fuel-injection. Fuel-injection equipment includes two nine-cylinder pumps, master control, equalizer, bar fuel lines and cylinder injection nozzles. Supercharger impeller is new "inducer" type which improves both efficiency and capacity of impeller. "Siamese" Y-type intake pipes serve two cylinders each. Some CA models inject fuel at supercharger impeller.

LUBRICATION.—Dry sump. Front sump pump scavenges to rear pump which supplies oil at pressure for lubrication. Front sump also has regulator for reduction-gear pressure. Crankcase has stationary oil jets built in.

IGNITION.—Either high or low-tension. Low-tension type includes one generator mounted on rear cover, two 18-point distributors mounted on front section and distributing low-tension current to high-tension coil on each cylinder. This system cuts leakage and arcing and eliminates long travel of high-tension current. No supercharging of ignition system necessary for high-altitude flights.

ACCESSORIES.—Rear cover strengthened for mounting of power take-off for cabin supercharging, etc. Double acting airscrew pitch control torquemeter, priming system, fire-seal adapter flange, cooling-air deflectors, accessory drives and covers, Scintilla magnetos.

OPTIONAL EQUIPMENT.—Manifold pressure regulator, .35 or .4375 reduction gears, anti-detonant (water injection) equipment.

DIMENSIONS.—
Diameter 56.59 in. (1,437 mm.).
Length (Model 975) 78.47 in. (1,993 mm.), (Model 749) 78.52 in. (1,994 mm.).

WEIGHTS AND PERFORMANCE.—
See Table.

THE WRIGHT TC18 TURBO COMPOUND.

The Turbo Compound combines an improved design R-3350 engine and three exhaust-driven "blow-down" turbines equally disposed around the engine. Power recovered from the engine exhaust gases by the turbines is fed back into the rear of the engine crankshaft by means of a gear train operating in conjunction with three fluid couplings. This compounding arrangement is claimed to convert into useful power approximately 20 per cent. of the available heat energy normally lost through the engine exhaust. The turbines are called "blow-down" turbines because the high velocity of the gases they use comes from the gas blowing down across the exhaust valve.

The Turbo Compound engine completed its first 50-hour Official Flight Approval Test in October, 1949, and in January, 1950, the 150-hour Official Navy Qualification Test was completed. Delivery of the first production engines began in March, 1950 and more than 11,900 had been delivered by the end of 1957. Between them they had accumulated 12.6 million commercial flying hours.

The following are some of the pertinent characteristics of the Turbo Compound engine :—

COMMERCIAL DESIGNATIONS.—972TC18DA3, 4 and 988TC18EA1, 2, 3, 4, 5, 6.

CYLINDERS.—Bore 6.125 in. (155.6 mm.). Stroke 6.312 in. (160.2 mm.). Swept

THE WRIGHT TC18 TURBO COMPOUND SERIES (COMMERCIAL).

Engine Model	Take-off Horsepower (low blower)	Take-off Horsepower (high blower)	Normal Rating (low blower)	Normal Rating (high blower)	Reduction Gear Ratio	Dry Weight	Fuel Grade
972TC18DA3	3,250 h.p. at 2,900 r.p.m. at 5,500 ft. (1,670 m.)	2,550 h.p. at 2,600 r.p.m. at 15,200 ft. (4,636 m.)	2,700 h.p. at 2,600 r.p.m. at S/L and 2,750 h.p. at 2,600 r.p.m. at 5,800 ft. (1,770 m.)	2,450 h.p. at 2,600 r.p.m. at 16,400 ft. (5,000 m.)	.4375 : 1	3,604 lb. (1,636 kg.)	115/145
972TC18DA4	3,250 h.p. at 2,900 r.p.m. at 5,500 ft. (1,670 m.)	2,550 h.p. at 2,600 r.p.m. at 15,200 ft. (4,636 m.)	2,700 h.p. at 2,600 r.p.m. at S/L and 2,750 h.p. at 2,600 r.p.m. at 5,800 ft. (1,770 m.)	2,450 h.p. at 2,600 r.p.m. at 16,400 ft. (5,000 m.)	.4375 : 1	3,596 lb. (1,632 kg.)	115/145
988TC18EA1, EA3	3,400 h.p. at 2,900 r.p.m. at 4,000 ft. (1,220 m.)	2,550 h.p. ar 2,600 r.p.m. at 15,200 ft. (4,636 m.)	2,860 h.p. at 2,650 r.p.m. at S/L and 2,920 h.p. at 2,650 r.p.m. at 4,800 ft. (1,465 m.)	2,450 h.p. at 2,600 r.p.m. at 16,400 ft. (5,000 m.)	.4375 : 1	3,645 lb. (1,655 kg.)	115/145
988TC18EA2, EA5	3,400 h.p. at 2,900 r.p.m. at 4,000 ft. (1,220 m.)	2,550 h.p. at 2,600 r.p.m. at 15,200 ft. (4,636 m.)	2,860 h.p. at 2,650 r.p.m. at S/L and 2,920 h.p. at 2,650 r.p.m. at 4,800 ft. (1,465 m.)	2,450 h.p. at 2,600 r.p.m. at 16,400 ft. (5,000 m.)	.355 : 1	EA2 : 3,745 lb. (1,700 kg.) EA5 : 3,775 lb. (1,714 kg.)	115/145
988TC18EA4, EA6	3,440 h.p. at 2,900 r.p.m. at 4,000 ft. (1,220 m.)	2,550 h.p. at 2,600 r.p.m. at 15,200 ft. (4,636 m.)	2,860 h.p. at 2,650 r.p.m. at S/L and 2,920 h.p. at 2,650 r.p.m. at 4,800 ft. (1,465 m.)	2,450 h.p. at 2,600 r.p.m. at 16,400 ft. (5,000 m.)	.4375 : 1	3,675 lb. (1,668 kg.)	115/145

NOTE : EA4 and EA6 have increased maximum cruise power 1,975 h.p. low blower, 1,950 h.p. high blower.

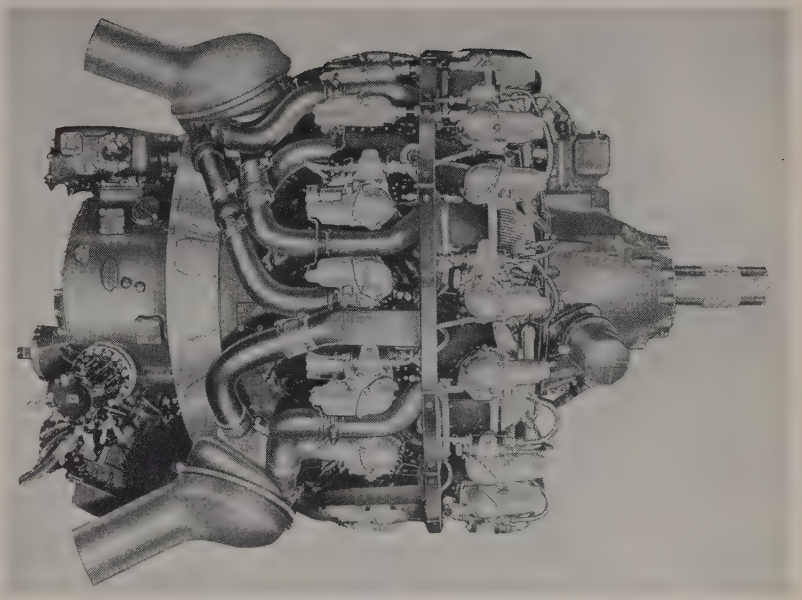
volume 3,347 cub. in. (54.56 litres). Compression ratio 6.7 : 1. Developed from C18BD1 forged cylinder with 40 per cent. more cooling fin area, additional attaching threads and increased radii at stress concentration points.

Crankshaft.—Two-throw 180° shaft in three sections as in C18 Series, but material added to centre and rear crank checks to increase strength of crankshaft assembly.

Valve Gear.—As in C18 Series except that both inlet and exhaust valves are sodium-cooled. Exhaust valve stem diameter also increased from $\frac{11}{32}$ in. to $\frac{3}{4}$ in. to provide extra margin of strength. Exhaust valve guides of HC-250, a high-carbon ($2\frac{3}{4}$ per cent.) high chromium (25 per cent.) cast structure bordering on tool steel analysis. Stellite split-ring floating type exhaust valve seats shrunk into head.

Supercharger.—Two-speed, gear-driven off extension shaft coupled to rear of engine crankshaft. Blower ratios 6.46 and 8.67 : 1.

Power Recovery Turbine System.—Consists of three "blow-down" exhaust-driven turbine units clamped and indexed to adapters bolted to engine front supercharger casing. Each turbine fed by exhaust from six cylinders through three paired pipes, two pairing adjacent cylinders in front and rear rows respectively, and one pairing adjacent front and rear cylinders. Turbine wheel has Stellite blades welded to Inconel X disc and is splined to stainless steel shaft aligned by two steel-backed silver bearings mounted at either end of shaft support pedestal. Turbine shafts are geared to extension shaft coupled to rear of engine crankshaft through three vortex-flushed fluid couplings using engine oil. Turbine cooled by ram air ducted from front of engine into enclosing muff and forced by 7-in impeller on shaft through holes at base of each wheel blade into upper turbine shroud with tangential outlet discharging into exhaust outlet. Turbine shaft support pedestal on spring diaphragm to permit wheel to move slightly in all radial directions. Upper end of pedestal equipped with plate-type friction damper in which half the plates are fixed to turbine nozzle support and half to pedestal. Loading between plates provided by eight springs compressed to pre-determined load. Lubricating oil supplied to turbine unit from drilled passage in front supercharger housing and is scavenged by gravity drain.



The 3,400 h.p. Wright TC18EA1 Turbo Compound engine.

Airscrew Reduction Gear Ratio (DA1, 2, 3, 4 and EA1, 3, 4, 6).—
0.4375 : 1.

Airscrew Reduction Gear Ratio (EA2 and 5).—
0.355 : 1.

Fuel Grade.—115/145.

Diameter (without cowling).—
56.6 in. (1,438 mm.).

Weights and Performance.—
See table.

THE WORLD'S AIRSHIPS

(CORRECTED TO SEPTEMBER 30th, 1958)

UNITED STATES OF AMERICA

The United States Navy is the only service in the World which operates airships and the sole supplier of airships to the U.S. Navy is the Goodyear Aircraft Corporation. Details of the current productions of Goodyear appear below.

In 1954 the U.S. Navy abandoned the former classification of its airships and introduced a designation system similar to that used for naval aircraft, in which letters are used to define the function and identity of the craft and numbers to indicate the model and its modifications. The prefix Z signifies Lighter-than-Air, while the letter G identifies the Goodyear Aircraft Corporation. Other letters used i.e. P (patrol), S (search) and W (warning), are standard for all types of naval aircraft.

The previous designations and the new designations for all airships currently in service in, or in production for, the U.S. Navy are as follows :—

Old	*New*
ZP2K	ZSG-2
ZP3K	ZSG-3
XZP4K-1	XZSG-4
ZP4K-1	ZSG-4
XZP5K-1	XZS2G-1
ZP5K-1	ZS2G-1
ZPN-1	ZPG-1
ZP2N-1	ZPG-2
ZP2N-1W	ZPG-2W

The former L and G Class ships (old designations ZTL and ZTG) are no longer in service. They were formerly employed for pilot training but have now been replaced by the ZSG-2 and ZSG-3, which are modernised versions of the original K Class (or ZPK) airships.

GOODYEAR



The Goodyear ZSG-4 Search and Anti-submarine Airship which is in production for the U.S. Navy.

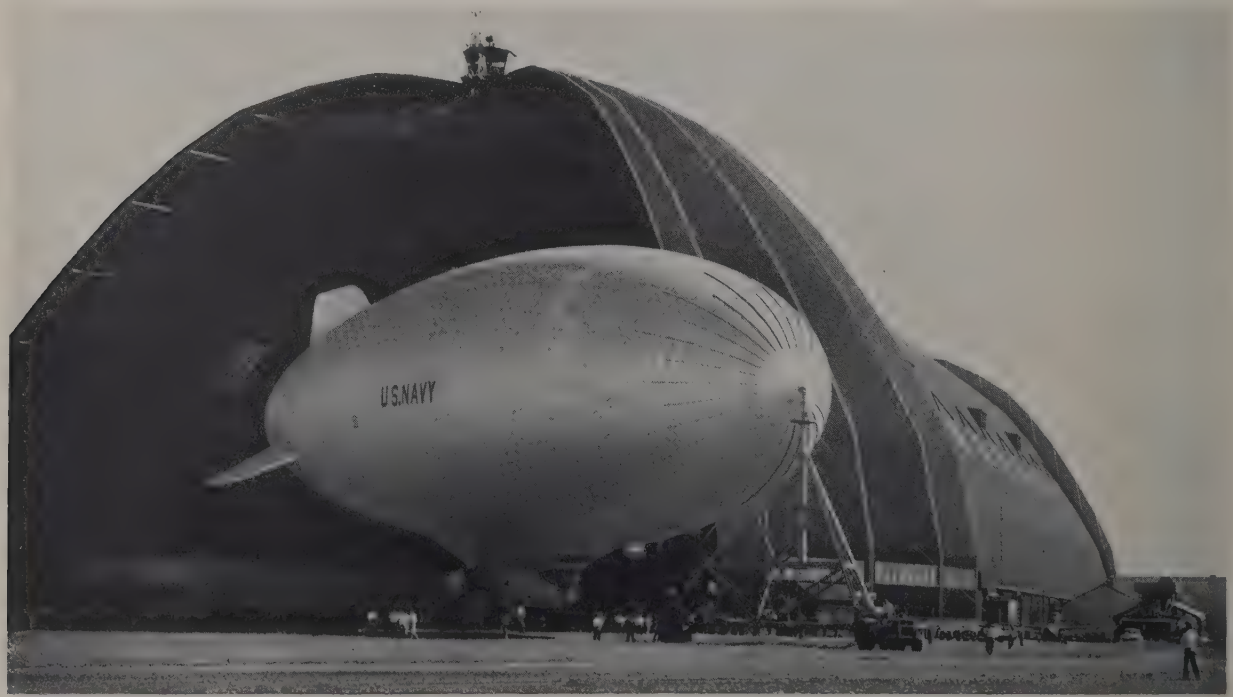
THE GOODYEAR AIRCRAFT CORPORATION.

HEAD OFFICE AND WORKS : AKRON 15, OHIO.

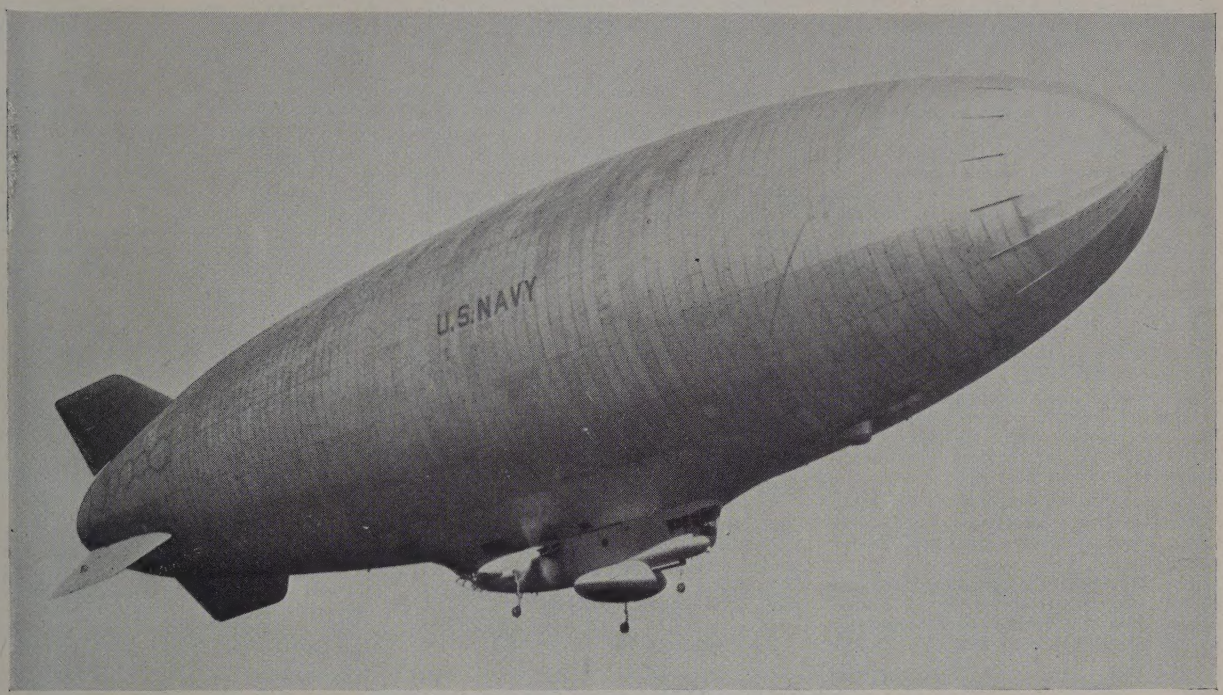
President : T. A. Knowles.
Vice President R. W. Richardson.
Chief Engineer : E. A. Brittenham.
Assistant Secretary : W. A. Runyan.

The Goodyear Aircraft Corpn. was formed on December 5, 1939, to take over from the parent Goodyear organization its principal manufacturing operations in the field of aeronautics, with the exception of tyres, inner tubes, bullet-proof fuel tanks and other rubber accessories. This also included the activities of the former Goodyear-Zeppelin Corpn., then mainly devoted to lighter-than-air craft.

During the war the Corporation was engaged in the manufacture of airships, aircraft, aircraft components and sub-assemblies. In the lighter-than-air field Goodyear fulfilled for the U.S. Navy a programme of upwards of 200 airships ranging from the L-type trainers of 123,000 cub. ft. (3,480 m.^{3}) capacity to the K and M patrol ships having a helium gas capacity of 456,000 cub. ft. (12,905 m.^{3}) and 725,000 cub. ft. (20,520 m.^{3}) respectively. After the completion of the airship programme in April, 1944, the activities of the Corporation were devoted



The Goodyear XZS2G-1, prototype of a new class of Search Airship for the U.S. Navy.



The Goodyear ZPG-2 Patrol Airship (two 800 h.p. Wright R-1300 engines). A ZPG-2 established a new endurance record in March, 1957, by remaining in the air without refuelling for 264.2 hours.

solely to the production of aircraft, parts and sub-assemblies, as well as the manufacture of Goodyear wheels, brakes and other specialised components.

To-day, the Goodyear Aircraft Corpn. continues its rôle as the sole supplier of airships to the U.S. Navy's lighter-than-air section.

All Goodyear airships are of non-rigid construction. The cars are supported by a system of steel cables laced through the top and bottom of the rubberised-fabric envelope. The metal framework of the control cars is built in several assemblies and then joined together. Goodyear Bondolite sandwich material consisting of aluminium-alloy facings with a balsa wood core, is used exclusively in the construction of the control cars.

THE GOODYEAR ZSG-4.

The ZSG-4 (formerly designated ZP4K-1) non-rigid airship, an intermediate search craft, is a development of the well-known former K-type of ship. The maiden flight of the prototype was made in December, 1953, and Goodyear is now under contract to build an undisclosed number of this type of airship for the U.S. Navy.

The ZSG-4 incorporates the latest developments adaptable to such craft for the purpose of locating and attacking submarines. Operational versatility and endurance is augmented with special equipment providing for in-flight refuelling and for re-ballasting by a water pick-up system.

The ZSG-4 has a helium capacity of 527,000 cub. ft. (14,915 m.^{3}), has a maximum speed in the neighbourhood of 75 m.p.h. (120 km.h.) and is manned by a crew of eight officers and ratings.

No further details are available for publication.

THE GOODYEAR ZS2G-1.

The ZS2G-1 (formerly ZP5K-1) is the first of a new class of non-rigid airship which is intended to replace the earlier K ships which were used in anti-submarine warfare service in the last war.

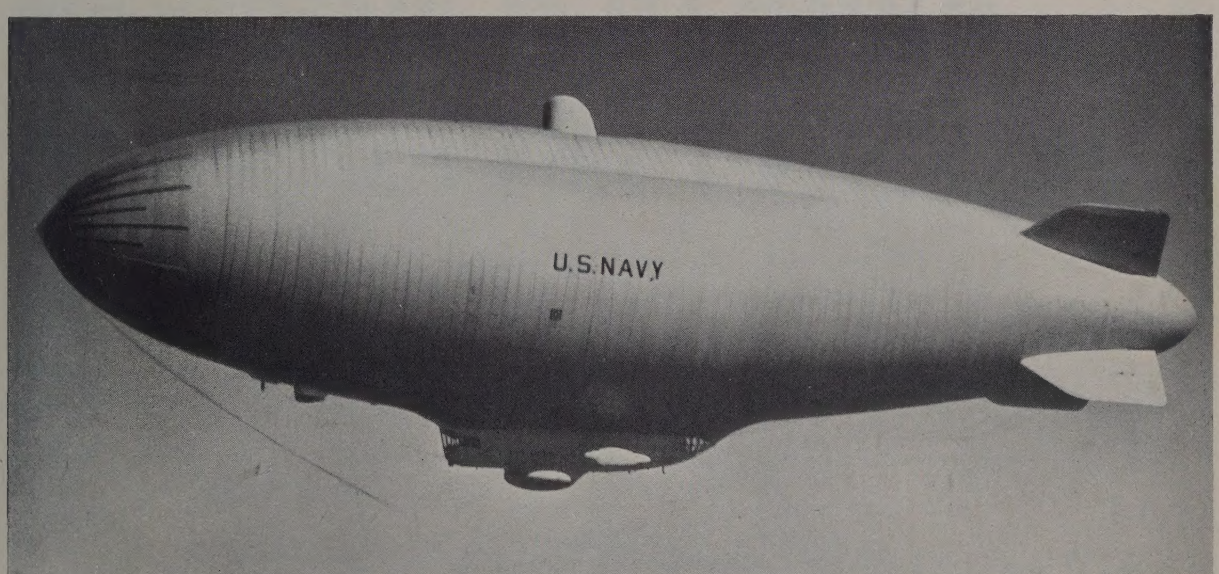
A notable feature of the new ship is the inverted "Y" configuration of the three control surfaces att, an arrangement evolved to prevent the accumulation of snow on the side control surfaces.

The ZS2G-1 is equipped with the latest developments adaptable to such craft for detecting, locating and attacking submarines. The airship can refuel in flight from surface craft and re-ballast by a water pick-up system. A crew of eight is carried.

An undisclosed number of ZS2G-1 ships are being built for the U.S. Navy. Car construction and assembly is undertaken at Goodyear's Akron factory, while the envelopes are being made at the company's Litchfield Park, Arizona, factory.

THE GOODYEAR ZPG-2.

The first new patrol ship to be built since the war was the ZPN-1, now designated ZPG-1, which was flown for the first time in 1951. As the result of extensive evaluation trials with this ship



The Goodyear ZPG-2W Early Warning version of the ZPG-2 Patrol Airship.

an improved and slightly larger version, the ZP2N-1, was put into production, the first P2N ship, since re-designated ZPG-2, making its maiden flight on March 20, 1953.

The ZPG-2 has a helium capacity of 975,000 cub. ft. (27,590 m.³). It is powered by two 800 h.p. Wright R-1300-2A radial air-cooled engines mounted in an engine room within the car and driving through shafts and gearing two 16 ft. 7 in. (5.06 m.) Curtiss Electric three-blade controllable-pitch, feathering and reversible airscrews mounted on outriggers projecting from each side of the car. In an emergency either engine can drive both airscrews. Both engines are accessible for maintenance and repair in flight, if necessary.

The control car, which accommodates a crew of fourteen officers and ratings, has two decks, with all operational stations on the lower deck and crew's quarters on the upper deck.

The tricycle landing-gear, comprising a nose wheel and two larger wheels, one under each airscrew outrigger, is retractable.

The four control surfaces on the stern of the ship are mounted at 45 degree angles from the vertical and horizontal and as all surfaces are operated in unison for either vertical or horizontal control they are known collectively as "rudde-vators."

The flight controls are subject to manual or automatic pilot operation. The pilot may control both vertical and horizontal direction alone or, in co-operation with a co-pilot, may divide the duties of maintaining altitude and direction. All controls can be operated through a single column, which is duplicated at the pilot and co-pilot stations.

The ZPG-2 has the latest developments adaptable to aircraft for locating and attacking submarines.

Special equipment will permit the ship to refuel in flight from a surface craft or to re-ballast from the ocean through a water pick-up system.

The ship's envelope is made of Neoprene-coated cotton and the control car is constructed of a sandwich material comprising a balsa wood core faced with aluminium-alloy sheet.

The first ZPG-2 set up a new World's Endurance Record in May, 1954, by remaining in the air for 200.4 hours. This record was exceeded in 1957 by another ZPG-2 ship, which remained in the air without refuelling from March 4 to March 15 for a total time of 264 hours 14 minutes.

For further details see Table.

THE GOODYEAR ZPG-2W.

The ZPG-2W is an AEW (Aircraft Early Warning) version of the ZPG-2 which was initially designed for anti-submarine operations. The 2W modification incorporates changes in the electronic equipment and the addition of a large radome, containing special electronic devices for aircraft detection, on top of the envelope. A 75-foot vertical tunnel of rubberised fabric with stiffeners is built inside the envelope to connect the electronic station on top of the envelope with the control car. In all other respects the ZPG-2W is similar to the previously-described ZPG-2.

THE GOODYEAR ZPG-3W.

The ZPG-3W, which has been built specifically as an airborne early warning (AEW) ship, is claimed to be the largest non-rigid airship ever built. It is said to be about 50 per cent. larger than the ZPG-2.

Powered by two 1,525 h.p. Wright R-1820 engines, the ZPG-3W carries a crew of 21 and will be equipped with the latest electronic detection equipment. The envelope itself serves as a radome for a "gigantic" internally-mounted radar antenna system. All further details are restricted.

The first ZPG-3W flew for the first time on July 21, 1958.

GOODYEAR AIRSHIPS BUILT FOR THE U.S. NAVY.

Class	Volume	Length	Height	Width	Engines	Max. Speed m.p.h. (km.h.)	Remarks
ZSG-2 and ZSG-3	527,000 cub. ft. (14,915 m.³)	267 ft. (81.4 m.)	84 ft. (25.6 m.)	70 ft. (21.3 m.)	2×550 h.p. Pratt & Whitney Wasp	over 75 m.p.h. (120 km.h.)	Originally K Class ships, the first of which was launched on December 8, 1938. 130 built during last war. U.S. Navy has modified many K ships to ZSG-2 (formerly P2K) and ZSG-3 (formerly P3K) standards with latest electronic equipment and increased power (550 h.p. Pratt & Whitney Wasp engines). Now used for training.
ZSG-4	527,000 cub. ft. (14,915 m.³)	267 ft. (81.4 m.)	84 ft. (25.6 m.)	70 ft. (21.3 m.)	2×550 h.p. Pratt & Whitney Wasp	over 75 m.p.h. (120 km.h.)	Development of former K Class as an intermediate search craft. Prototype flew in December, 1953. In production.
ZS2G-1	650,000 cub. ft. (18,200 m.³)	285 ft. (86.9 m.)	92 ft. (28.0 m.)	68 ft. (20.7 m.)	2×800 h.p. Wright R-1300-4 Cyclone 7	over 85 m.p.h. (136 km.h.)	Newly-designed replacement of the former K Class ships. No details available for publication. Prototype flew on July 22, 1954. In production.
ZPG-1	875,000 cub. ft. (24,760 m.³)	324.4 ft. (98.8 m.)	94.5 ft. (28.8 m.)	73.5 ft. (22.4 m.)	2×800 h.p. Wright R-1300-2A Cyclone 7	over 85 m.p.h. (136 km.h.)	Completed in 1951. Prototype only.
ZPG-2	975,000 cub. ft. (27,590 m.³)	343 ft. (104.6 m.)	96.5 ft. (29.4 m.)	75.5 ft. (23.0 m.)	2×800 h.p. Wright R-1300-2A Cyclone 7	over 85 m.p.h. (136 km.h.)	First production ZPG-2 made its first flight on March 20, 1953. ZPG-2 ships have established two World's endurance records, the first in May, 1954, at 200.4 hours and the second in March, 1957, at 264.2 hours, both without refuelling.
ZPG-3W	approx. 1,500,000 cub. ft. (42,500 m.²)	—	—	—	2×1,525 h.p. Wright R-1820-88 Cyclone 9	—	Larger version of ZPG-2W (see above). First ZPG-3W flew for first time on July 21, 1958.

Printed in England by
NETHERWOOD DALTON & Co. Ltd.
HUDDERSFIELD

• RANGEFINDERS • BINOCULARS • ELECTRONIC INSTRUMENTS • GUNNERY CONTROL INSTRUMENTS • SPIRAL BEVEL GEARS • PRECISION MECHANISMS • INTERFERENCE LIGHT FILTE
• PLANE GUNSIGHTS

Messrs. Barr & Stroud Limited

specialise in the design and manufacture of high precision machines and instruments, Mechanical, Optical and Electronic, for Navy, Army and Air Force. Their extensive works are fully equipped with modern plant, permitting rapid quantity production of the highest quality.

Their Research Laboratories and Development Departments are controlled and staffed by highly trained Mechanical Engineers, Physicists and Electronics Engin- , experienced in carrying out projec- ide variety and complexity.

Founded in 1888
by
Professor Archibald Barr
Professor William Stroud

BARR & STROUD

LIMITED

WORKS: ANNIESLAND, GLASGOW, W.3.
Telephone: SCOTSTOUN 4241. *Telegrams:* "Telemeter, Glasgow".

London Office: 15 Victoria Street, Westminster, S.W.1.
Telephone: ABBey 6433. *Telegrams:* "Retemelet, Phone, London"

REFERENCE ONLY

CONTRA COSTA COUNTY LIBRARY
3 1901 00735 7280